NAVY
Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research (ONR). The Navy SBIR Program Manager is Mr. Vincent D. Schaper. Inquiries of a general nature may be brought to the Navy SBIR Program Manager's attention and should be addressed to:

Office of Naval Research
ATTN: Mr. Vincent D. Schaper
ONR 362 SBIR
800 North Quincy Street
Arlington, VA 22217-5660
(703) 696-8528

All SBIR proposals should be submitted to the above address and must be received by the date and time indicated in Section 6.2 "Deadline Of Proposal" appearing in the front part of this DOD solicitation.

The Navy's SBIR program is a mission-oriented program which integrates the needs and requirements of the Navy primarily through science and technology dual-use, critical technology topics. A total of 31 Science and Technology (S&T) areas has been identified (see Table 1). While all of these areas may not be funded equally during the annual DOD SBIR solicitations in which the Navy participates, topics will be funded according to a priority it has established to meet its mission goals and responsibilities.

This solicitation contains a mix topics. Please read the information contained in the front portion of this solicitation carefully before sending your proposal. The Navy's part of the solicitation contains topics which permit latitude for small businesses to submit their solutions to Navy requirements and will be on the INTERNET under ONR or ONR Homepage. We are attempting to provide proposers the opportunity to send their proposals on diskette for this solicitation. From the ONR Homepage on the INTERNET under the SBIR section you will be able to go to the Navy part of this solicitation and "pull down" into your computer an SBIR format for filling out your SBIR Proposal on disk which could be mailed to the above address together with a single signed hard copy. All proposals sent on disk should be written using one of the following software packages: WordPerfect 5.1, 5.2, 6.0; WordStar 2000 1.0, 2000 2.0, 2000 3.0, 3.3, 3.4, 4.0, 5.0, 6.0, 7.0; MultiMate 4.0; MS Word for Windows 1.0 or 2.0; MS Word 4.0 or 5.0; or Display Write 4.0 or 5.0. However, unlike the solicitation on the INTERNET under the Defense Technical Information Center (DTIC) you will not be able to ask questions. Any questions you want to ask must come through the INTERNET under DTIC SBIR Solicitation. A listing of selections for awards for the Navy SBIR solicitation will be listed on the INTERNET under DTIC and Navy Homepages.

When preparing your proposal keep in mind that Phase I should address the feasibility of the solution to the topic. Be sure that you clearly identify the topic your proposal is addressing. Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which have been invited to submit a Phase II proposal by the Navy technical point of contact (TPOC) during or at the end of successful Phase I effort will be eligible for a Phase II award. All Phase I and Phase II proposals should be sent to the Navy SBIR Program Office for proper processing. Phase III efforts should be reported to the SBIR program office noted above.

As in the past solicitation the Navy will provide potential awardees the opportunity to reduce the gap between Phases I & II if they provide a $70,000 maximum feasibility Phase I proposal and a fully costed, well defined ($30,000 maximum) Phase I Option to the Phase I. The Phase I Option should be the initiation of the demonstration phase of the SBIR project (i.e. initial part of Phase II). When you submit a Phase II proposal it should consist of three elements: 1) a $600,000 maximum demonstration phase of the SBIR project (i.e. Phase II); 2) a transition or marketing plan (formally called "a commercialization plan") describing how, to whom and at what stage you will market your technology to the government and private sector; 3) a Phase II Option ($150,000 maximum) which would be a fully costed and well defined section describing a test and evaluation plan or further R&D if the transition plan is evaluated as being successful. While Phase I proposals with the option will adhere to the 25 page limit (section 3.3), Phase II proposals together with the Phase II option will be limited to 40 pages. The transition plan should be in a separate document.

Evaluation of proposals to the Navy will be accomplished using scientific review criteria. Selection of Phase I proposals will be based upon technical merit and other criteria as discussed in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

TABLE 1. NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY AREAS

TECHNOLOGY	SCIENCE
Aerospace Propulsion and Power	Computer Sciences
Aerospace Vehicles	Mathematics
Chemical and Biological Defense	Cognitive and Neural Sciences
Command, Control, and Communications	Biology and Medicine
Computers	Terrestrial Sciences
Conventional Weapons	Atmospheric and Space Science
Electron Devices	Ocean Science
Electronic Warfare	Chemistry
Environmental Quality and Civil Engineering	Physics
Human-System Interfaces	Electronics
Manpower and Personnel	Materials
Materials and Structures	Mechanics
Medical	Environmental Science
Sensors	Manufacturing Science
Surface/Undersurface Vehicles	
Software	
Training Systems	

NAVY SBIR PROGRAM MANAGERS OR POINTS OF CONTACT FOR TOPICS

TOPIC NUMBERS	POINT OF CONTACT	PHONE
068-076, 078, 081-097 and 099-101	Mr. Douglas Harry	703-696-4286
102-106	Mr. Joseph Johnson	703-640-4801
107-121	Ms. Betty Geesey	703-696-6902
122, and 157-163	Mr. Eugene (Gene) Patno	805-989-9209
125, 126, 132, 134, 147, 151-153, and 156	Ms. Carol Van Wyk	215-441-2375
123, 127-129, 135-140, 145, 146, and 148-150	Ms. Cathy Nodgaard	703-604-2437 x6309
077, 124	Mr. Ed Linsenmeyer	904-234-4161
130, 141, 173, 197, and 198	Ms. Beth Klapach	301-743-4953
131 and 133	Mr. Charles (Chuck) Sullivan	317-353-7998
142 and 223	Ms. Janet Wisenford	407-380-8276
143, 144, 179, 180 and 194	Ms. Patricia (Pat) Schaefer	202-767-6263
154 and 155	Mr. Peter (Pete) O'Donnell	908-323-7566
164, 166, 167, 169, 171, 172, 174, 176, 177, 181, 186, 209, and 211	Mr. William (Bill) White	703-602-3002
165, 170, 182 and 187-190	Mr. Frank Halsall	301-227-1094
080, 098, 168, 175, 178, 183-185 191, 204, 210 and 219-221	Mr. Donald (Don) Wilson	301-394-1279
192, 193, 195, 196 and 199-203	Mr. Jim Linn	812-854-1352
79, 205-208 and 212	Mr. John (Jack) Griffin	203-440-4116
213-215	Lcdr Paul Knechtges	301-295-0885
216-218	Ms. Linda Whittington	703-607-1648
222 and 224	Dr. Meryl Baker	619-553-7681
225-227	Mr. Nicholas (Nick) Olah	805-982-1089

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N95-084 Innovative Repair/Maintenance Materials for Navy Piers and Wharves

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N95-161 Pulse Width Modulated Valves for Liquid Fuel Control

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N95-163 3-Dimensional Perspective Transformer at Video Rates

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N95-173 Develop Passivated Pyrophoric Metal Powders

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N95-178 Develop Customized Training Using Artificial Intelligence Methods

N95-179 Develop a Unified Architecture for a Real-Time Distributed, Electronic Warfare (EW) Simulation

N95-180 Develop a Real-Time, Wave Propagation Model for Heterogeneous Clutter Scenes.

N95-181 Surf Zone and Craft Landing Zone Obstacle Clearance.

N95-182 Develop Aluminum Stabilization of NbTi Superconducting Wire

N95-183 Design, Develop, and Demonstrate a Low Power Digital Signal Processing Multichip Module for Mine Warfare

N95-184 Develop a Miniature, Low Power Ocean Bottom Seismometer/Accelerometer (S/A)

N95-185 Develop a Miniature Magnetometer

N95-186 Develop and Produce a Large Screen Color LCD Projection System

N95-187 Develop a Miniature Diode Laser Velocity Sensor

N95-188 Develop Stealthy Materials for Moving Systems in the Sail of Submarines

N95-189 Development of Manufacturing and Assembly Methods for the Production of Acrylic/Fused Silica, Laminated, Composite, Heated Periscope Head Windows Using Electro-Conductive Coating Heating

N95-190 Develop and Produce New Elastomeric/Plastic Foam Materials for Shock Wave Attenuation

N95-191 Connection of Simulation Based Design (SBD) and Advanced Distributed Simulations (ADS) for Military System Development.

N95-192 Develop Mechanical and Environmental Test Procedures for Transmit/Receive (T/R) Modules Procedure

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N95-194 Develop a Channelized Direction Finder

N95-195 Development of an Automated Logistics Software to Implement Hardware Change Control and Parts Control from Problem/Failure Reports of the Cooperative Engagement Capability (CEC) Program.

N95-196 Develop a Lightweight Electronic Equipment Enclosure

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N95-198 Prompt Formation of Metallic Vapor Clouds

N95-199 Data Compression Techniques on Microwave Link

N95-200 Development of Rapid Prototyping of Application Specific Signal Processors (RASSP) Program Interface for the Cooperative Engagement Capability (CEC) Program

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N95-204 Develop Robust Nonlinear Control Technology

N95-205 Develop a Left/Right Passive Bearing Ambiguity Resolution Sensor (BARS) for Torpedo Defense

N95-206 Develop and Produce High Precision Sensors for Under-Ice Submarine Operations and Unmanned Undersea Vehicle (UUV) Missions

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DEPARTMENT OF THE NAVY SBIR 95.3 TOPIC DESCRIPTION

OFFICE OF NAVAL RESEARCH

N95-068 TITLE: User-interfaces for Rule-Based Formal-Methods Environments

OBJECTIVE: Develop enabling technology that will enhance the ability of software engineers to apply formal-methods techniques to safety-critical applications.

DESCRIPTION: Formal methods offer great promise for the elimination of software errors in safety-critical systems. Before formal methods can be widely adopted in industry, they must be supported by tools readily acceptable to professional programmers. Of particular importance are tools that couple the creation of formal specifications with automatic or semi-automatic tools (theorems and proof-checkers) for the verification of such specifications. Existing formal-methods tools are often hobbled by weak, obscure, amateurish, or non-standard user-interfaces. In addition, the supporting tools are not mature, nor are they integrated with commercial CAD/CASE tools. The long-range goal is to create a high-level, customizable, portable, common user-interface tailored to formal-methods applications. A near-term objective is to address the many straightforward applications realizable by a set of rules that take an input and a state to an output and a new state, and which are amendable to formal verification technologies. Often such designs have a practical tabular representable and are a useful intermediate step towards a target language code generation such as in Ada or C.

PHASE I: Develop a design for a software prototype of a "formal-methods interface" (FMI). This FMI must address and justify coordination management among back-end theorem provers, model-based simulation and the FMI. Important FMI features and capabilities should be described through "storyboard" illustrations.

PHASE II: Create a prototype FMI usable with several theorem-proving and proof-checking systems (e.g., PVS, HOL, Nth, Nuprl, and Coq), model-based systems (e.g., FDR), and simulation system for appropriate demonstration purposes with instantiations of the FMI for many of the candidate formal-methods systems.

PHASE III: Potential follow-on efforts are anticipated on government projects in software safety-critical systems and in particular on C^4I projects.

COMMERCIAL POTENTIAL: The development of safety-critical systems is carried out by both defense-related and non-defense-related companies such as aerospace applications, medical software, automotive control, and micro-processor chip design and testing. Improved tools for formal-methods techniques would have significant impact both in training and in production applications. Growing numbers of applications stand to benefit from the application of formal-methods techniques. Society is increasingly at risk because of the lack of their application as recently witnessed with the floating point arithmetic failure of the Intel Pentium microprocessor which did not verify the correctness of its design. Increased computing power and improvements in implementations of verification tools offer a real chance for these techniques to have significant impact. A formal-methods interface could help as a catalyst for quicker acceptance.

REFERENCES:

1. G. Cherry, Software Engineering with Ada in a New Key: Formalizing and Visualizing the Object Paradigm, "Proceedings of TRI-Ada '94", November 1994.
2. R. Constable, et al.; Implementing Mathematics with the Nuprl Proof Development System. Prentice-Hall, Englewood Cliffs, NJ, 1986.
3. J. Cuadrado; Teach formal methods. Byte, December 1994.
4. L. Thery, Y. Bertot, and G. Kahn; Real theorem provers deserve real user-interfaces. Proceedings of the Fifth ACM SIGSOFT Symposium on Software Development Environments, (Tyson's Corner, VA, Dec. 9-11, 1992), ACM SIGSOFT Software Engineering Notes 17, 5 (December 1992), pp. 120-129.
5. S. Owre, N. Shankar, and J. M. Rushby; The PVS Specification Language (Draft), Computer Science Laboratory, SRI International, Menlo Park, CA, March 1993.

N95-069 TITLE: Uncertain Data in Information Engineering

OBJECTIVE: To develop algebraic techniques for processing uncertain, imprecise, and conditional information with variable conditions in a way faithful to both logic and probability.

DESCRIPTION: Information engineering concerns the organization and management of large amounts of data on an "enterprise-wide" basis. Management information systems must handle information which might be uncertain, probabilistic, non-monotonic, temporal, default, propositional, or fuzzy. Often such information arises in real world situations (e.g., when only partial information is available, or information is hypothetical). Current language standards (e.g., SQL) do not fully address the range of possible information type interactions. This can lead to inconsistent results. For example, the use of null values in a DBMS may lead to query results different from a DBMS that uses default values for representing partial information. Another example involves material implication of classical logic. With the closed-world assumption material implication can be easily expressed as a propositional statement; however, in a context where both propositions and facts are uncertain, this identification may not be warranted. All information has context and conditions under which valid inferences are made. The lack of understanding of these conditions and rules of inference may lead to problems in the fusion of information.

PHASE I: Develop a mathematical basis for the fusion of different types of information as mentioned above; identify problems where current approaches may lead to inconsistencies, contradictions, or the absence of meaningful information; and develop approaches to identify and remove circularities, redundancies and inconsistencies in a knowledge base.

PHASE II: Develop a functional prototype that is operable with and extends a standard query language (e.g., SQL or KQML) that is based on the results of Phase I. Validate this prototype on realistic problems that have arise in C^4I systems.

PHASE III: Potential follow-on efforts include government projects in database, statistical databases, software safety-critical systems, and in particular on C^4I projects.

COMMERCIAL POTENTIAL: This technology applies to data bases, knowledge-bases, artificial intelligence, robotics, Bayesian analysis, computer languages, statistical contingency data analysis, and theoretical computer science. Current methods of managing and reasoning from uncertainty data are ad hoc. This effort seeks to raise the level of assurance in the quality and reliability of the answer to any query involving uncertain information. The commercialization potential results from a robust software product and for impacting query language standards.

REFERENCES:
1. Dubois, D. and Prade, H. (1991). "Conditioning, Non-monotonic Logic, and Non-standard Uncertainty Models", in: I.R. Goodman, M.M. Gupta, H.T. Nguyen and G.S. Rogers, eds., Conditional Logic in Expert Systems, (North-Holland, Amsterdam) 115-158. ADA241664
2. Goodman, I. R., Nguyen, H. T. and Walker, E. A. (1991A) Conditional Inference and Logic for Intelligent Systems: A Theory of Measure-Free Conditioning, North-Holland. ADA241568
3. Gunter, Carl, (1992) "Powerdomains, Conditional Event Algebras, and their Applications in the Semantics of Programming Languages", Final Technical Report, March 25, 1992, University of Pennsylvania Department of Computer and Information Science.

N95-070 TITLE: High Power Electronics

OBJECTIVE: Develop semiconductor power amplifiers capable of controlling 10 times the voltage and 40 times the power of present silicon devices.

DESCRIPTION: Innovative new approaches have shown that high bandgap (e.g., > 2 eV) semiconductors exhibiting significant improvements in thermal conductivity, dielectric strength, and charge carrier velocity may now be synthesized with purities approaching that in silicon. This capability will enable thrusts emphasizing (1) high power actuators and motor controllers capable of replacing hydraulic devices on ships and aircraft, (2) high power microwave/millimeter wave vacuum tube replacement amplifiers, and (3) efficient and versatile electric drive systems for ships and vehicles.

PHASE I: Demonstrate 10-fold improvement over silicon in breakdown strength of a small device.

PHASE II: Demonstrate 40-fold improvement (over silicon) in power output from an amplifier of equivalent dimensions.

PHASE III: Demonstrate a microwave power amplifier exhibiting 5 times the power output of a GaAs device of the same dimensions.

COMMERCIAL POTENTIAL: This will advance the state-of-the -art for all electric vehicles.

REFERENCES:

1. Matus, L. G., Powell, J. A., and Salupo, C. S.,"High Voltage 6H-SiC p-n Junction Diodes", Appl. Phys. Lett. 59, pp.1770-2 (1991).
2. B. J. Baliga, "New Materials beyond Silicon for Power Devices" in "Power Semiconductor Devices and Circuits", Ed. by A. Jaecklin, Plenum Press, New York, pp. 377-388, (1992).

N95-071 TITLE: Gallium Nitride (GaN) Based Blue-Green Emitters on Silicon-on-Insulator (SOI) Substrates

OBJECTIVE: Develop large area (8-inch diameter) Silicon Carbide (SiC) substrates made from SOI wafers, and blue-green light emitters fabricated using Gallium Nitride (GaN) and Indium Gallium Nitride (InGaN) on these (SiCOI) substrates--using Aluminum Nitride (AlN) buffer layers, and integrate the emitters with Si-based logic devices on the same wafers.

DESCRIPTION: A high quality compliant substrate called SiCOI contains low defect density, thin, cubic silicon carbide layer on SiO_2 on Si, and is made from a commercially available 8-inch or 5-inch diameter SOI substrate. SiCOI can be a platform for integration of wide bandgap semiconductors with Si-based logic. Blue light emitting diodes (LEDs) based on GaN can be fabricated on SiCOI at much lower cost than on sapphire or SiC substrates now in use for GaN-based devices.

PHASE I: Develop process for conversion of thin Si layer on top of SOI wafer to cubic SiC with low defect density, evaluate characteristics of SiC layers, and initiate growth of GaN-based structures on these SiCOI wafers.

PHASE II: Fabricate GaN-based LEDs on SiCOI wafers and optimize process for conversion of SOI to SiCOI.

PHASE III: Develop 5-inch and 8-inch SiCOI substrates for SiC-based electronics, transmitter for optical bus communication, (consisting of LED array on SiCOI chip with integrated LED driver circuits and DRAM buffer on the base Si wafer), and related chips to integrate LEDs with Si devices.

COMMERCIAL POTENTIAL: Integration of blue and green LEDs with Si logic for optical communication and display applications, and low cost SiC substrates for high temperature, high power devices.

REFERENCES:

1. Powell, A.R., Iyer, S.S., and LeGouses, F.K., "New Approaches to the Growth of Low Dislocation Relaxed SiGe Material," Appl. Phys. Lett. 64 (14), 4 April 1994.
2. S. Nakamura, T. Mukai, M. Seno, "High Power GaN P-N Junction Blue-Light Emitting Diodes," Jpn. J. Appl. Physics, 30, L198 (1991).

N95-072 TITLE: Optoelectronic Signal/Image Processing for C3I Applications

OBJECTIVE: Develop optoelectronic technology and/or signal processing modules that will support command, control, communications, and intelligence (C3I) systems; specifically, multi-function phased array antennas.

DESCRIPTION: Future systems will reduce the number of separate shipboard and airborne antennas by sharing adaptive phased array antennas, multifunction receiver modules, and common signal processing resources. Enabling technologies for this concept include wideband phase shifters, high dynamic range fiber optic links (140 dB/2 GHz), methods for adaptive multiple-beam steering, optical techniques for addressing and interconnecting large numbers of wideband target recognition modules, and robust methods of automatic target recognition (ATR). Fiber optic links with high spurious free dynamic range (>140 dB) are needed to achieve the required receive only signal distribution for the next generation surface combatant. Proposals which exploit the inherent parallelism of optical systems or the speed/bandwidth of photonic technology, including nonlinear optical phenomena, will be considered.

PHASE I: Investigation of proposed concept; identification of innovation and discussion of technical issues. If possible, given technical status and funding, conduct laboratory demonstration proving feasibility of concept or resolution of controversial issue.

PHASE II: Design of prototype; demonstration of concept with prototype system; discussion of all relevant performance scaling issues and production or manufacturing issues.

PHASE III: Develop Phase II prototype; demonstrate in naval system.

COMMERCIAL POTENTIAL: The wideband technology components and systems developed for this program have numerous private sector applications within the high-speed telecommunications, satellite communications, and digital multimedia distribution markets. In addition, relevant software products designed for efficient resource allocation and data fusion are equally applicable to industrial concerns.

N95-073 TITLE: Ultra-High Isolation Circulator/Duplexer for Surveillance and Communication

OBJECTIVE: The objective of this effort is to develop the most feasible approach to obtain more than 120 dB of isolation in a UHF (200 to 1850 MHz) M port circulator/duplexer. Other performance criteria include low insertion loss (3 dB) and 60 dBm peak power handling capability for transmit and receive applications.

DESCRIPTION: The Navy has constraints in its ability to add new antenna systems to its ships due to the proliferation of antennas currently adorning their topside real estate. One solution to this problem is to combine shipboard systems to utilize a single antenna aperture thereby reducing the number of antennas required and making space available for new ones. To do this Ultra-High Isolation Circulators/Duplexers, exceeding 120 dB, need to be available to achieve the required isolation between transmit and receive functions as well as between systems. This problem is currently referred to as Electromagnetic Interference (EMI) and our goal is to obtain Electromagnetic Compatibility (EMC) between collocated systems.

PHASE I: This part of the investigation will entail defining the problem and assessing the current state of isolator technology in Active (solid state), Passive (ferrite), and Emerging (cancellation) technologies that will lead to solutions. Further, an initial design and demonstration of the isolation properties of the successful approach, and a prototype design of a three port Ultra-High Isolation Circulator/Duplexer, should be addressed.

PHASE II: This part of the investigation will entail transitioning the successful isolation technology to an two-port isolator, a three port circulator, and an M port circulator which meet the program specifications and packaging requirements for both Military and Commercial applications.

PHASE III: The successful devices from Phase II will be transitioned into a Navy Advanced Technology Demonstration.

COMMERCIAL POTENTIAL: The commercial sector will make use of ultra-high isolation circulators in the automobile and communications industries. A specific example of an application would be to combine functions such as global positioning, personal (cellular) communications, and intelligent vehicle highway system functions into a single wideband aperture mounted on/in the roof of a vehicle. These systems will be coming to automobiles by the year 2000 and the need for this technology to be identified in order to obtain the required system performance.

REFERENCES:
1. Goto, "The Impact of Mobile Radio Communications", IEEE Antennas and Propagation Transactions, Vol. 34, pp. 22-29, April 1992., IEEE Microwave Theory and Techniques Transactions

N95-074 TITLE: Underwater Autonomous Power Generation

OBJECTIVE: The objective of this work is to develop a system to trickle charge batteries on the sea floor using mechanical energy available from the local environment.

DESCRIPTION: Future autonomous oceanographic sampling systems will use small autonomous underwater vehicles deployed for many months. The vehicles will recharge their batteries at docking stations on the ocean bottom that contain a cache of batteries. Mechanical, solar and/or thermal energy will be used to trickle charge the battery cache. The focus of this effort is a mechanical system for recharge that utilizes wave and current energy as available near-bottom. Two configurations are envisioned: shelf and deep ocean. The system should be compact, rugged and intelligently manage input mechanical energy types/levels and optimum cycling of state-of-the-art batteries (e.g., lead-acid, silver-zinc, lithium).

PHASE I: System design and evaluation of engineering/cost trade-offs including expected power output in representative ocean regimes and management of different battery types.

PHASE II: Fabrication, testing and evaluation of prototype systems deployed in the ocean (shelf and deep regimes) for at least one month.

PHASE III: Transition of the system to the autonomous oceanographic sampling networks for basic research, mine countermeasure and ordinance disposal missions.

COMMERCIAL POTENTIAL: Commercial applications include powering sensor systems for environmental monitoring and prediction, for satellite ground truth, for marine navigation, for fisheries management and for resource development. Common to these applications is the need for remote, undersea measurements with infrequent service intervals to be cost-effective. Local power generation will extend the service life of such systems and enable more data to be telemetered in real time through satellite and cellular phone links.

REFERENCES:

1. Curtin et al., 1993. Autonomous Oceanographic Sampling Networks. Oceanography, 6(3): 86-94.

N95-075 TITLE: Inertial Navigator on a Chip

OBJECTIVE: The objective of this work is to develop a low cost, low power inertial navigation system in a microprocessor form factor for use in small autonomous underwater vehicles.

DESCRIPTION: Future autonomous oceanographic sampling systems will use small autonomous underwater vehicles deployed for many months. Absolute geolocation, attitude and precise relative navigation are critical capabilities for such systems. A geo-located inertial navigator is sought using new micro-electro-mechanical technology. Sensors and signal processing hardware/software should be integrated within a single low power microprocessor-scale chip. In addition to power and cost, utility will be determined by the drift rate, which should be minimized, and the capability to detect the local geographic reference frame (magnetic north, local gravity). The network-class vehicles of interest have a speed range of 1 to 5 knots, and are stable in attitude to within a few degrees. Long intervals of submerged operation will limit access to the satellite-based global positioning system, which should not be relied on as a primary input.

PHASE I: System design and evaluation including sensitivity, drift rate, power consumption and geo-location accuracy.

PHASE II: Fabrication, testing and evaluation of a prototype system deployed on a network-class vehicle operating in the ocean for at least one month.

PHASE III: Transition to the Autonomous Oceanographic Sampling Network for basic research, mine countermeasure and ordinance disposal missions.

COMMERCIAL POTENTIAL: Commercial applications include environmental monitoring and prediction, satellite ground truth, marine salvage, and fisheries management. The many industries associated with these activities will benefit.

REFERENCES:
1. Curtin, et al., 1993. Autonomous Oceanographic Sampling Networks. Oceanography, 6(3): 86-94.

N95-076 TITLE: Data Management and Satellite Relay for Environmental Research Aircraft

OBJECTIVE: Development of a data management system and in-flight satellite telemetry capability for real-time data analysis and interactive in-flight aircraft operations.

DESCRIPTION: Innovative data management and satellite telemetry schemes are solicited to support environmental research. Over-the-horizon communications are required to fulfill long duration (24 hour) and long range measurement strategies. In addition, researchers must be able to monitor data collection for real-time decision making and flight operations. The system that is solicited here shall: a) coordinate data streams from various onboard sensors (possibly operated in different configurations), b) provide onboard storage of all data collected, and c) telemeter selected data, video, and all flight control commands via satellite communications to a ground station for real-time analysis and system operation. The command and control system shall use a currently available communication satellite (such as INMARSAT) that continuously provides at least 1200-baud data average transmission rates. Innovative data handling schemes will be required to collect, process, and transmit high data rates from a variety environmental sensors and flight control systems.

PHASE I: Describe a system concept complete with data management and telemetry capabilities.

PHASE II: Produce a viable prototype system and demonstrate it's ability to support in flight data management and telemetry of scientific data and flight control commands from an operating Cessna 337-type research aircraft.

PHASE III: Transition the technology to vendors and customers.

COMMERCIAL POTENTIAL: Data management and over the horizon communications for research aircraft can be used to support a variety of world meteorological, oceanographic, and commercial needs.

N95-077 TITLE: <u>Nonlinear Signal Enhancement and Bandwidth Reduction of Image Data Using Computational Fluid Dynamics Techniques</u>

OBJECTIVE: Develop and demonstrate feasibility of signal enhancement and bandwidth reduction, using nonlinear dynamical techniques, applicable to image data which will provide the capability of recovery from transmission errors and provide improved storage efficiency and increased data transmission rates.

DESCRIPTION: Image enhancement techniques based on various transform and statistical approaches are well developed, and their success is well known. Nonlinear techniques based on dynamical approaches are more recent in their development, but promise novel signal processing capabilities. It is envisioned that significant advances in error reduction and data transmission rate may be possible using these nonlinear techniques. The specific application required here is to detect partially obscured mines and barriers, minefields and barrier fields in general, in the surf zone and in shallow water.

PHASE I: Develop a signal processing technique for improving mine and minefield (and barrier and barrier field, and mixed) detection capabilities in the surf zone and shallow water using the indicated nonlinear signal enhancement techniques which will outperform or at least compete with existing techniques. Compare the technique against typical images and typical (even stressing) levels of background clutter and varied background textures.

PHASE II: Produce and demonstrate a finished software package of ready-to-use algorithms for mine and minefield (as well as barrier, barrier field, and mixed) detection, classification, and identification based on the developed nonlinear approaches which will run on a shipboard or airborne personal computer.

PHASE III: Bring the finished software package into production in a form that meets Navy needs for application to littoral warfare.

COMMERCIAL POTENTIAL: Software and related hardware developed would provide enhanced capabilities in medical imaging, satellite imagery, paramilitary reconnaissance, and industrial applications.

REFERENCES:
1. S. Eidelman, W. Grossmann, and A. Friedman, "Nonlinear Signal Processing Using Integration of Fluid Dynamics Equations," Proc., SPIE 1567, 439-450 (1991).

N95-078 TITLE: <u>Four-dimensional (4-D) Oceanographic Instrumentation</u>

OBJECTIVE: To develop innovative instrumentation to measure oceanographic and/or meteorologic parameters.

DESCRIPTION: Innovative sensors and measurement techniques are solicited to obtain marine atmospheric and oceanographic variables (e.g., acoustical, optical, physical, biological, chemical, and geophysical) in 3-D space and time. The emphasis must be placed on (1) novel approaches and concepts for measuring multiple parameters coherently in 4-D, and (2) new methods of measuring turbulent fluxes, acoustic wavefields, or fluid motion of multi-phase mixtures (e.g., water/bubbles/sediments/biologics). Instruments can be individual towed/tethered sensors, elements in arrays, or suites of instruments on unmanned vehicles/platforms to cite a few examples. Low cost, reliable and possibly expendable sensors/components are particularly desirable. Full depth capability is desired in instrumentation planned for subsurface use. Particular capabilities are sought for bubble and spray population measurements, dynamic void fractions in water, small scale turbulent fluxes of heat mass & momentum, and near bottom sediment fluxes.

PHASE I: The Phase I effort should provide a description of exactly what will be measured and to what accuracies and coherence as well as providing the design concept for achieving the measurements. Phase I should produce a proof of concept by demonstrating untested concepts or instruments.

PHASE II: The Phase II effort would develop hardware and demonstrate feasibility via laboratory and/or field testing.

PHASE III: Phase III would transition the instruments to ocean science researchers, ocean monitoring systems and operational DOD systems.

COMMERCIAL POTENTIAL: New instruments/technology can be used in commercial ocean monitoring systems.

N95-079 TITLE: Innovative Multimedia Man Machine Interface Concepts

OBJECTIVE: To develop interactive man machine interface concepts which will reduce undersea platform operator workload and present an easily understood array of information to afford a clear and accurate picture of the tactical environment.

DESCRIPTION: A need exists for the development of an interactive man machine interface capable of presenting data from multiple sources and of varying types to an operator in a clear, unambiguous manner, while minimizing the workload required of the operator. This man machine interface must be able to present to an operator all information about a tactical situation pertinent to the type of task being performed, e.g., acoustic warfare, drug interdiction, air traffic control, and allow the operator to interrogate the data and vary the level of data presented as required by the situation. This man machine interface must present data in real time highlighting important features of the environment/situation in an easily recognizable manner.

PHASE I: Explore multimedia man machine interface concepts

PHASE II: Implement concepts in a prototype for demonstration with data fusion technology developments

PHASE III: Transition prototype to production systems

COMMERCIAL POTENTIAL: The display of data to operators becomes an increasingly more difficult task as the amount and types of data to be presented increases. This is true in a military application such as acoustic warfare as well as the tracking of targets and weather for the FAA, or the sorting of possible drug trafficking aircraft in a busy traffic corridor. As systems develop to higher levels of complexity, more data is available for exploitation. In order not to completely overwhelm the system operators, the man machine interface must be carefully designed to present the data in a user friendly and natural way. The use of multimedia technology may provide a better means to help an operator have a clear understanding of the situation in which he/she is working.

N95-080 TITLE: High Temperature Batteries for Underwater Vehicle Propulsion

OBJECTIVE: Demonstrate the performance capability of high temperature batteries to increase the range and speed of underwater systems.

DESCRIPTION: The silver oxide/zinc (AgO/Zn) battery is the Navy's workhorse power supply for driving a number of its underwater vehicles, like Swimmer Delivery Vehicles, Deep Submergence Rescue Vehicles, torpedoes and torpedo targets. For such use, AgO/Zn offers the highest energy density of any commercially available, high power rechargeable battery. However this energy density is still insufficient to power the run times needed by future vehicles especially at sea water temperatures. Under these conditions a high temperature battery has the potential to provide three to four times the gravimetric energy density. Naval vehicles require from 100 to 160 volts for 6, 10 and 20 hour periods, typically, and most applications require no more than 100 cycles. The space for the power supply is often limited to an 18- or 36-inch diameter.

PHASE I: Design a high temperature battery power supply for underwater vehicles. Evaluate energy and power densities (both gravimetric and volummetric) as a function of the energy content and physical size (including all ancillary components)of the high temperature battery. These should include all additions to the battery to assure safe operations in the vehicle, on the deployment platform, and in storage.

PHASE II: A specification will be provided for a specific application which will be representative of one or more of the sizings from Phase I. Bench top demonstration of the high temperature battery chemistry.

PHASE III: Transition for further development into the ONR High Energy Battery Task (RJ14Y41).

COMMERCIAL POTENTIAL: Electric vehicles for civilian use. Quiet electric vehicles for front line military use.

REFERENCES:

1. E.J. Cairns, The Electrochemical Society Interface, Winter 1992, p.39.
2. Anon., International Defense Review, September 1991, p.944.
3. Handbook of Batteries and Fuel Cells, D. Linden, ed., McGraw-Hill, New York, 1984. Table 26-6, pp. 26-9.

N95-081 TITLE: Nonlinear Dynamics of Crane Operation at Sea

OBJECTIVE: The goal of this research is to devise automated crane operating procedures based on the nonlinear dynamics of crane cable motions at sea to allow the safe transfer of cargo in Sea State 3 and above.

DESCRIPTION: The Navy uses crane ships to transfer cargo to smaller, lighter ships at sea when ports are not available for the heavier crane ship. The cargo is in standardized large containers. This transfer operation becomes dangerous when the condition Sea State 3 is reached. This corresponds to 3 1/2 to 4 foot waves. Pendulation of the crane cable occurs as the load is lowered. In addition, the larger crane ship responds more to ocean swells, while the light ship is more effected by the local wave conditions. Highly skilled operators can still operate in Sea State 3, so safe operation is possible. Automated nonlinear dynamical control techniques have experimentally proved to be successful in controlling unstable behavior in lasers, circuits, actuators, and cardiac tissue. It is hoped these types of nonlinear controls can be applied to crane operation.

PHASE I: A realistic theoretical and numerical study of the operation of a three dimensional Navy style crane on a ship being driven by wave motions. This should illuminate all possible motions and instabilities in the crane-load dynamics as a function of Sea State. Automated control techniques will be developed and demonstrated. This can include developing a protocol of operation using available operator controls and data inputs, as well as, suggesting feasible design modifications and additional data input devices, eg motion sensors.

PHASE II: The theory of crane operation will be tested experimentally on a model with progressively higher sea states. This will include picking up a load and transferring it to a lighterage ship. Control will be applied in an automated manner to minimize cable oscillations.

PHASE III: Automated crane operation at sea will be tested on a Naval vessel.

COMMERCIAL POTENTIAL: Maritime fleets would benefit from safer crane operations at sea and increased efficiency by maintaining operations in higher Sea States.

N95-082 TITLE: High Efficiency Organic Light Emitting Diodes

OBJECTIVE: The simple fabrication of high efficiency (>4%), organic light emitting diodes using conventional, economical, processable polymers and simple room temperature processing.

DESCRIPTION: Overcome difficulties with conventional polymer light emitting diodes, which include (1) mismatch between the work-functions of the anode and the cathode materials and, respectively, the π and π^* orbitals of the electroluminescent polymer that result in a significant increases in operating voltage of the devices, (2) low mobility of injected charge carriers in undoped conjugated polymers (10^{-5} to 10^{-2} $cm^2/V.s$), (3) space charge effects near the electrodes limiting the carrier concentrations, (4) combination of low carrier mobility and low carrier concentration resulting in weak current (low brightness). (3) unbalanced densities of injected holes and electrons because at the two polymer/metal interfaces and resultant dependence of recombination rate on population of minority carriers (excess majority carriers simply reduce device efficiency).

PHASE I: Develop innovative solutions using alternative device architectures to overcome the above difficulties and exploit the phenomenon of polymer electroluminescence. Develop a novel approach to the injection of charge carriers into a conjugated polymer.

PHASE II: Reduce phase I effort to engineering practice.

PHASE III: Scale up synthesis/fabrication/processing to pre-production level; fabricate devices for air/fleet evaluation such as advanced information displays for Naval aircraft and vessels.

COMMERCIAL POTENTIAL: Displays for watch dial illumination, illuminated toys, and illuminated novelties.

N95-083 TITLE: Two-Dimensional Ultrasonic Imaging Array Transducer

OBJECTIVE: Devise materials processing methods to make a pulse-echo ultrasonic imaging transducer having the form of a two-dimensional array for forming three-dimensional images.

DESCRIPTION: Currently, ultrasonic images are made by sending an acoustic probe pulse and detecting returning echoes with a single element transducer or a line array of transducer elements; two-dimensional images are made by either mechanically or electrically scanning the acoustic beam in a plane. In order to speedily image a three-dimensional volume, two-dimensional arrays of transducer elements are needed. Fabricating the large number of very small transducer elements and providing the necessary electrical connections to each element presents demanding material synthesis and processing challenges, especially in obtaining a transducer material with high electro-mechanical conversion efficiency, in tailoring each element's electrical impedance to interface it efficiently to the transmit/receive electronics, and in matching the array acoustically to the imaging medium without introducing interelement crosstalk. This topic focuses on solving the materials issues in fabricating the two-dimensional transducer array rather than acoustics or electronics issues which are also needed for three-dimensional imaging.

PHASE I: Demonstrate materials fabrication methods for a two-dimensional array of ultrasonic transducer elements with electrical interconnections to all elements. Determine acoustic and electric properties of candidate structures.

PHASE II: Devise materials processing methods to fabricate two-dimensional ultrasonic transducer arrays complete with acoustic backing and matching layers and electrical connections. Fabricate a prototype transducer array with high element sensitivity, high interelement isolation, and appropriate electric and acoustic impedance. Form three-dimensional acoustic images using the array.

PHASE III: Construct the transmit/receive and image display electronics to form three-dimensional volumetric ultrasonic images in real-time.

COMMERCIAL POTENTIAL: Key component of pulse-echo ultrasonic imaging systems for Navy undersea mine classification, non-destructive material evaluation, and medical diagnostic imaging.

REFERENCES:
1. R. L. Goldberg and S. W. Smith, "Multilayer 2D Array Transducers with Integrated Circuit Transmitters and Receivers: A Feasibility Study," Proceedings of the 1994 IEEE Ultrasonics Symposium.

N95-084 TITLE: Innovative Repair/Maintenance Materials for Navy Piers and Wharves

OBJECTIVE: Develop novel materials and processes applicable to Navy shore infrastructure for rapid repair and maintenance of concrete structures.

DESCRIPTION: Navy piers, wharves, and other waterfront structures must withstand regular usage with a minimum of maintenance and scheduled repair in an intrinsically aggressive marine environment. In addition, these structures must constantly stand ready for very heavy surge usage during critical times with little potential for extensive repairs either before or during surge periods. Innovative scientific, technological, or both approaches are needed to support the development of alternative cementitious (hydraulic) systems, repair materials and processes to maintain the integrity of concrete structures or return the structure to its design strength, and novel nondestructive inspection/evaluation procedures specifically designed to evaluate the integrity of large marine concrete structures.

PHASE I: During Phase I the contractor will be expected to survey current repair and maintenance techniques and contrast them with proposed replacement materials, processes, inspection techniques for naval shore concrete structures. Pilot demonstrations of minor repairs of cracking or surface spallation would be desirable.

PHASE II: Phase II should concentrate on the development of an integrated approach to pier and wharf maintenance and repair including inspection and repair materials and processes. Concepts for the accelerated screening of repair and maintenance concepts would be very desirable attributes of a Phase II effort. The compatibility of techniques to modern lightweight concretes would be a further advantage to any materials developed during Phases I or II.

PHASE III: Phase III would be expected to follow a successful Phase II with the contractor participating in the establishment of standard procedures that would be applicable to naval structures and in the supply of materials and processes and expertise to further development and application.

COMMERCIAL POTENTIAL: Although Navy shore structures have unique requirements with respect to surge usage coupled with often lower general usage and requirements for structural flexibility in usage, the structures themselves are virtually identical to commercial piers, wharves, and other waterfront structures. Repair materials and inspection techniques developed for Navy structures will be capable of direct application in commercial structures.

N95-085 TITLE: Explosions of Particle Clouds Comprised of Reactive High Temperature Materials in Air

OBJECTIVE: Develop methodology to disperse and ignite clouds of self-sustaining reactive materials using SHS (self propagating high temperature synthesis) technology, in order to achieve superior fuel/air explosive capability.

DESCRIPTION: It is essential to develop the methodology to ensure ignition and self propagation of solid fuels in dispersed fuel/air reactions. These systems normally have a tendency to quench because of the rapid volumetric expansion during dispersion. Consequently, the use of intermetallic/ceramic reactions such as SHS technology is needed in order to ensure that complete combustion and maximum performance can be achieved.

PHASE I: Develop an understanding of the conditions required for ignition and propagation of the SHS and subsequent fuel/air reactions. Demonstrate the capability to inject and form SHS particle clouds in air and to measure the explosion blast pressure.

PHASE II: Develop and demonstrate the capability to disperse and ignite clouds of reactive SHS fuel particles such that complete fuel/air combustion is achieved. Conduct fuel/air test demonstrations and measure performance (blast pressure). Optimize experimental conditions such as dispersion conditions, choice of reactive materials, particle size, morphology, and porosity of system to maximize performance characteristics.

PHASE III: Transition technology into specific weapons programs for military application, and explosions/fire safety programs for industrial application.

COMMERCIAL POTENTIAL: The technology developed under this effort can be used to develop an understanding of dust cloud explosions which are serious concerns in several industries, such as coal mines, flour mills, and metal powder factories. The U.S. Bureau of Mines, Pittsburgh Research Center Fires and Explosions Office has expressed interest in supporting Phase II awardees in the adaptation of the processes developed here, for Phase III work in industrial programs.

REFERENCES:
1. J. E. Gatia and V. Hiavacek, Ceramic Bulletin, Vol 69, No. 8, 1990

N95-086 TITLE: CFD Code for Surface Pressure Fluctuations

OBJECTIVE: Develop a computational fluid dynamics (CFD) code for the prediction of spatially correlated pressure fluctuations on the surface of a structure in an incompressible turbulent flow sufficient for determining the resulting structural vibrations.

DESCRIPTION: Structural vibrations due to spatially correlated pressure fluctuations on a structure in a turbulent flow lead to unwanted acoustic emission to the interior or exterior fields. Prediction of these fluctuations is necessary for development of appropriate noise reduction techniques and/or control of the fluctuations themselves. Within the code adequate temporal and spatial resolution of the pressure fluctuations is required for the spatial correlations.

PHASE I: Develop a basic code to capture the essential features of the pressure fluctuations, including spatial correlations, for a turbulent flow over a simple geometry (eg., flat plate). Demonstrate extendability to practical configurations and flow conditions.

PHASE II: Develop, test, and demonstrate an operational code for practical geometries and flows. The code should be compatible with one or more standard gridding techniques and produce wave-number/frequency pressure predictions on the surfaces.

PHASE III: Produce a code incorporating the Phase II features for practical flow configurations as occur on naval vessels, commercial aircraft, automotive vehicles, and other industrial flow applications.

COMMERCIAL POTENTIAL: The code would find ready application in a number of industries addressing a wide variety of flow noise problems on naval, aerospace, and automotive vehicles, and numerous other fluid flow applications.

REFERENCES:

1. ASME NCA-Vol. 11 (Book H00713), 1991

N95-087 TITLE: Improvements to Naval Ship Engines Through Water Addition

OBJECTIVE: Investigate and develop potential modifications to Naval diesel engine and gas turbine engine cycles by using water addition to improve performance and reduce exhaust emissions.

DESCRIPTION: Engines used to power Navy ships are typically modifications to hardware designed originally for aircraft or land transportation applications. One modification that has not been exploited in the ship environment is the opportunity to introduce considerable amounts of clean water into the engine cycle. Recent advances in the production of fresh water from salt and brackish waters have now made it possible to consider water addition to engine cycles at rates equal to or greater than the fuel flow. It is known that if significant amounts of water are available, new thermodynamic cycles can be constructed so as to improve efficiency, raise power density, and/or reduce exhaust emissions. All of these characteristics have particular benefit to Naval applications where power plant and fuel occupy a large fraction of the platform. In addition, the detectability and survivability of a Naval ship are also quite dependent on the emissions and reliability of the power plant. It is therefore desired to examine how the thermodynamic, fluid control, and combustion chemistry effects of air breathing ship engines can be re-optimized through the introduction of water to various locations of existing or appropriately modified Naval engine configurations.

PHASE I: Identify modifications to thermodynamic cycles using water augmentation, and develop optimization procedures. Characterize the effects of water addition on compression, combustion, control systems, and exhaust emissions. Examine the behavior of water injection/sprays for various geometries, flow fields, and temperature conditions.

PHASE II: Select engine arrangements that demonstrate the benefits of water addition, and perform testing new components. Explore water production methods appropriate to the needs of the cycles, rates and purity needed. Prepare preliminary designs of water augmented power plants as configured for shipboard installation.

PHASE III: Assemble a prototype engine and demonstrate, in cooperation with an engine manufacturer, its performance. Submit final designs showing engine, water systems, exhaust, and shipboard modifications needed for both a retrofit and a new ship application.

COMMERCIAL POTENTIAL: Many engine types used on Naval ships are also used on commercial ships. While the Naval optimization is different, a large part of the new water addition technology will be transferable. By bringing the engine manufacturer into the development, it is expected that the commercial applications will be accelerated, especially for engines with demonstrated performance. In addition, this technology should show considerable promise for land based engines where water is available, for example in power plants. The commercial potential seems highest in the areas of reduced pollution from exhaust gases and increased power density.

N95-088 TITLE: Actuators and Sensors Placement for Active Control

OBJECTIVE: Develop and demonstrate techniques and devices for optimal placement of actuators and sensors for active noise and vibration control.

DESCRIPTION: Active control of noise and vibration has received a great deal of attention and achieved a certain level of practicality. However, active control methods have some limitations and drawbacks that additional research and development efforts are needed for further implementations. These efforts include optimal placement for sensors and actuators, effective control strategy, and affordable control system components. For active control of sound radiation from structures, it is more effective to use structural sensing technique at the nearfield to estimate the far-field acoustic pressure. Collocated sensor/actuator control technique is stable, robust, and economical if the sensors and actuators are integrated properly. To be effective, control algorithms must be model-independent and do not require excessive computing. Most important, current control strategy needs to be extended to off-resonant, and broadband vibration and acoustic control.

PHASE I: Concept formulation: develop concepts and techniques for optimal placement of sensors and actuators for active control of noise and vibration on structures. Select applications and develop devices for test and evaluation.

PHASE II: Design, fabricate, test and evaluate devices to demonstrate the capabilities of optimal placement techniques. Demonstrations are conducted on practical systems commonly found in both military and commercial applications.

PHASE III: Transition methodology, technology, and devices to practical and engineering problems in both defense and commercial industries.

COMMERCIAL POTENTIAL: This technology would have direct applications to control noise and vibration on vibrating structures, such as aircraft structure, machinery, ground transportation vehicles, and home appliances.

REFERENCES:
1. Burdisso, R. A. and Fuller, C. R., Theory of Feedforward Controlled Systems Eigenproperties, Journal of Acoustical Society of America, 1990.
2. Dosch, J. J., Inman, D. J., and Garcia, E., A Self-sensing Actuator for Collocated Control," Journal of Intelligent Materials and Structures, January 1992.
3. Hagood, N. W. and Anderson, E. H., Simultaneous Sensing and Actuation using Piezoelectric Materials," SPIE Conference on Active and Adaptive Optical Components, July 1991.
4. Liang, C., Sun, F. P., and Rogers, C. A., An Investigation of the Energy Consumption and Conversion of Piezoelectric Actuators Driving Active Structures, Proceedings of the Second International Conference on Intelligent Materials, June 1994.

N95-089 TITLE : Simulation of Fracture in Fluid Structural Interaction

OBJECTIVE: Develop a dynamic fracture simulation capability for design and analysis of hull structures for dynamic events such as underwater explosion, ship grounding, and fatique.

DESCRIPTION: Several structural dynamics software programs are now used by the industry in crashworthiness analyses and other severe impact applications. In addition hydro codes have been developed for the simulation of shock and underwater explosions. None of these codes is capable of simulating the fracture process in large submerged structures, because they rely on finite element or finite difference which use structured meshes. Finite element methods are quite limited in their capabilities to simulate fracture, because cracks can generally only be modeled along the directions of the element edges. Therefore, modeling of arbitrary crack growth by finite elements requires continuous remeshing. The major breakthrough has been the development of the Element-Free Galerkin (EFG) computational method that is able to simulate fracture very accurately. This method is often called a meshless or gridless method, as the method requires only nodes. The interpolants which are used for the unknowns are moving least-square interpolants. In the EFG method, arbitrary cracks can move through the solid, and the problem of interest is modeled by a set of nodes and a Computer Aided Design-like model for the outside and inside surfaces of the structure, including any cracks which are modeled. The analyst does not have to know where cracks are emanating from and which direction they are propagating. Crack initiation and propagation criteria are provided by the user; the program then implants nodes and moves nodes in the direction of the crack with no elements or connectivity to be tracked.

PHASE I: Develop computer code capability base on Element-Free Galerkin. Perform the analysis of dynamic loading on a plate and compare its fracture. Demonstrate the coupling with existing hydrodynamic software for canonical geometries of submerged shells. Demonstrate strategy for parallel processing.

PHASE II : Couple code with existing hydrodynamic code for fluid simulation. Develop, test, and demonstrate the simulation capability for general geometries. Implement parallel processing for efficient computation.

PHASE III: Develop a general code with user documentation

COMMERCIAL POTENTIAL: Applications to: car and aircraft crashworthiness analysis, oil tanker grounding (design, litigation etc.), off-shore oil rig safety, power and gas industry safety and environmental impact studies.

REFERENCES:
1. T. Belytschko, "Element Free Galerkin Method," Keynote Address, Society of Engineering Science, 31st Annual Tech. Meeting 10-12, 1994.
2. B. Nayroles, G. Touzot and P. Villon, "Generalizing the Finite Element Method: Diffuse Approximation and Diffuse Elements," Computational Mechanics, 10, pp. 307-318, 1992.
3. T. Belytscko, Y. Y. Lu, and L. Gu, "Element Free Galerkin Methods," Int. Jnl. for Numerical Methods in Engineering, 37, pp. 229-256, 1994.

N95-090 TITLE: Parametric Analysis of Naval Ship Systems

OBJECTIVE: The objective of this effort is to develop a set of advanced design algorithms and implement them in the form of a software package which will allow a user to perform parametric analysis of shipboard systems (PASS). Specifically, PASS will rely heavily on first principles analytical models of all significant aspects of shipboard systems. The impact of parametric changes of a given system will be represented by the change to the system itself as well as its interaction with other systems. As a result, PASS will enable ship designers and systems engineers alike to assess the effects of changes in size, weight, and performance of a multitude of fundamental parameters defining operational systems and ship performance.

DESCRIPTION: PASS will enable navy ship designers to parametrically evaluate changes in systems and operational requirements on overall system performance. The basic core of PASS will have the capability of defining all significant subsystems of a ship, based on first-principles algorithms, to a level of detail sufficient to verify the feasibility of the ship with a proper balance of weights, volume and power. Additionally, the PASS user interface will allow a user friendly implementation of the models, while allowing the user to define the ship design to a useful level of detail. The advanced version of PASS will enable ship designers to assess overall shipboard improvements in survivability, covertness, and operational efficiency with the option to specify the platform.

PHASE I: Define all relevant systems (i.e., structure, propulsion, power plant, electrical, communications, weapons, etc.) and platform characteristics (i.e., size, displacement, volume, required complement, etc.), and compile these definitions into an analytical model.

PHASE II: This part of the development of PASS will involve enhancing the scope and accuracy of the first principles algorithms and verifying them by performing a detailed analysis on a representative test ship such as a modern guided missile destroyer. Also, a cost analysis modeling feature will be added to PASS. Most of the effort in Phase II will be focused on assessing and improving the models of shipboard systems and costs. This version of PASS will allow ship designers to quickly and accurately determine the payoff of parametric changes in system performance for a current or future ship design.

PHASE III: The refined version of PASS from Phase II shall further be developed to encompass the description of parameters related to ship survivability, covertness and operational efficiency. As in Phase II, essential improvements to existing models will be carried out, as well as the addition of new models as required to describe new shipboard systems as well as emerging technologies as they develop. In addition, PASS will become SURPASS and will incorporate sockets to CAD, NE, and IR packages which will allow optional implementation of platform specific analysis.

COMMERCIAL POTENTIAL: The commercial sector will make use of PASS in the design of both marine and terrestrial vehicles. The technology developed will be particularly useful to leverage small engineering firms into the automobile, bus, and marine vessel design and development sectors. Specifically, PASS will aid in the design of advanced fuel efficient vehicles and will eventually enable modeling of futuristic capabilities such as Intelligent Vehicle Highway System functions in particular.

N95-091 TITLE: Near-Infrared Fluorophores for Advanced Array Biosensors

OBJECTIVE: Produce new fluorophores suitable for biosensor signal transduction with excitation wavelengths greater than 665 nm and having electrophilic functionalities for covalent attachment to proteins and nucleic acids.

DESCRIPTION: In order to better exploit fiber optic biosensing based on fluorescence detection (via intensity, ratioed intensity or lifetime), reactive near-infrared fluorophores are required (to match diode laser sources and optical fiber transmittance). These fluorophores should contain electrophilic substituents (maleimide, N-hydroxy succinimidyl ester, isothiocyanate, haloacetyl or imidoester) for easy covalent attachment to protein and nucleic acid nucleophiles. They should be good fluorophores (quantum yield >20%, extinction coefficient >100,000 M^{-1} cm^{-1} in last absorption band, reasonably photostable) and soluble in water at ~1 mg/ml near pH 7 (<5% co-solvent if necessary). Peak absorbance should be no lower than 665 nm with peak emission in the range 690-1000 nm. Desirable excitation wavelengths include 670, 690, 790 and 830 nm (750nm and 850-1000 nm are undesirable). A series of affordable fluorophores is anticipated, with emphasis on solvent-insensitive emission (although high solvent sensitivity is also of interest). Combinatorial synthetic approaches might be considered.

PHASE I: Demonstrate synthesis of representative fluorophore (lacking electrophilic functionality if necessary), measure fluorescence emission spectrum.

PHASE II: Design, synthesize and characterize a series of reactive fluorophores with the desired properties. In consultation with the sponsor, attach these to representative proteins and nucleic acids and evaluate

PHASE III: Optimize and scale-up synthesis of best candidates from Phase II and prepare for transition to commercial production.

COMMERCIAL POTENTIAL: Civilian applications of near-infrared fluorescence-based biosensors in Clinical Diagnostics, Medical Imaging (both integrated into fiber optic networks eventually), Environmental Monitoring, Workplace Monitoring, Process Control and Applied Science are likely to be important.

REFERENCES:

1. Red and Near-Infrared Fluorometry by Richard B. Thompson (in Topics in Fluorescence Spectroscopy, Volume 4: Probe Design and Chemical Sensing, edited by J. R. Lakowicz, pp 151-181, Plenum Press, New York, 1994).

N95-092 TITLE: A Rapid In Vitro Diagnostic Kit to Detect and Identify Interferon-alpha in Patient Fluid Samples

OBJECTIVE: To develop solid-phase membrane technology (utilizing immunology/nucleic acid probes) for a commercially available in vitro diagnostic (IVD) kit that will rapidly detect, identify and semi-quantify interferon-alpha in patient fluid samples. This technology will assist the health care provider in distinguishing acute viral infections from acute bacterial infections and reduce the use of inappropriate drugs for the treatment of afflicted naval personnel either in a deployed field environment or in out-patient clinics.

DESCRIPTION: The government has a need for a diagnostic kit for rapid identification of interferon-alpha in patient fluids. Recently it has been recognized that interferon-alpha may represent a clinically useful marker for acute viral infections. However, no clinically useful assay for interferon-alpha exists, although the peptide sequences of several of the interferon-alpha subtypes associated with viral infections are known. Available information should allow the design of a probe specific for the consensus sequence of interferon-alpha subtypes that is suitable for use in a solid-phase membrane-based kit. The availability of such a kit should allow reliable detection of interferon-alpha subtypes associated with human viral infections without the use of special equipment.

PHASE I: Design/develop a specific probe suitable for a solid-phase membrane-based IVD kit that is reactive with human interferon-alpha subtypes commonly associated with acute viral infections in patient fluid samples.

PHASE II: Validate the sensitivity and specificity of the IVD kit with acute phase human serum/plasma samples or other body fluids from confirmed viral and bacterial infections.

PHASE III: Evaluate the IVD kit under field-deployed conditions and submit for Food and Drug Administration approval per regulatory requirements for IVD kits.

COMMERCIAL POTENTIAL: It is widely recognized by clinicians that acute viral infections are indistinguishable from acute bacterial infections on clinical grounds, and the current practice is to prescribe antibiotics in the event that the infection is of bacterial origin. Being able to rapidly distinguish between viral and bacterial infections with clinical specimens will reduce this inappropriate use of antibacterial drugs in patients experiencing flu-like symptoms. A kit with this capability will both reduce costs of health care delivery and reduce the unnecessary build-up of drug resistant bacteria in human populations. The kit technology to be developed under this topic is directly applicable to manufacture of other IVD kits for clinical diagnosis.

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1. Raymond, J., et al. Absence of intrathecal synthesis of some interferon-alpha subtypes in bacterial meningitis. J Infect. Dis. 166:657-659, 1992.
2. De Boissieu, D. et al. Viral infection in the neonatal period: diagnostic difficulties, the role of interferon alpha levels. Pediatrie (Bucur) 46:677-684, 1991.

N95-093 TITLE: Biofilters for Reduction of Gaseous Emissions

OBJECTIVE: Develop biofilters suitable for removal of volatile organic carbon (VOC) or volatile sulfur-containing compounds.

DESCRIPTION: Emissions of VOC or sulfur may create health hazards or cause noxious odors, and some emissions are regulated under the Clean Air Act. Sources of VOC and sulfur on shipboard include holding tanks for sewage, oily bilge and hazardous solvents. VOC emissions result from manufacturing, maintenance and disposal operations at DOD bases. Biofiltration devices can be engineered to provide efficient and cost-effective approaches to reducing emissions both on ship and shore. VOC and toxic sulfur emissions can be effectively removed using biologically based filtration systems such as biofilters, biological trickling filters and bioscrubbers.

PHASE I: Screen microorganisms for gaseous waste transformation; design physical-chemical support system for biofiltration.

PHASE II: Develop lab-scale biofiltration model to confirm transformation of emissions to benign products. Engineer scale-up to working model, and evaluate use in ship and shore applications.

PHASE III: Identify dual-use applications of biofilters for commercialization. Applications will include emission reduction on shipboard and at military bases, as well as reduction of industrial emissions in a variety of manufacturing processes.

COMMERCIAL POTENTIAL: Compliance with the Clean Air Act of 1990 will require innovative and cost-effective technologies. Markets for biofiltration technology are currently estimated to be in excess of $1 billion.

N95-094 TITLE: Haptic Interface Technology for Telerobotics and Virtual Reality

OBJECTIVE: Exploit and implement recent developments in the science of haptic sensing and sensor-driven control in humans and robots to advance the technology of haptic interfaces for telerobotic and virtual reality systems.

DESCRIPTION: There are a number of recent developments in the science of haptic sensing (touch and kinesthesis) and sensor-driven control in humans and robots that can inform the design of haptic interfaces for telerobotic and virtual reality systems in applications that require perception of features such as object shape, compliance, impact, contact, sliding, slipping, and kinematic constraint. These developments include microsensors, haptic display devices, and display algorithms for encoding the feel and movement of real or virtual objects during manipulation or exploration. They also include advances in our understanding of the nature of haptic feedback needed to create a realistic haptic experience. The objective of this SBIR is to implement these promising scientific developments.

PHASE I: Carry out feasibility study for incorporation of advanced haptic sensors, display devices and haptic display algorithms into haptic interfaces for specific telerobotic or virtual reality systems. Provide demonstration of the feasibility.

PHASE II: Implement haptic interface technology in prototype hardware or software products. Demonstrate interface for application such as remote robotic manipulation, remote surgery, virtual environments for training.

PHASE III: Develop for commercialization haptic interface technology for telerobotic or virtual reality displays prototyped in PHASE II.

COMMERCIAL POTENTIAL: Haptic interfaces have a commercial potential in a wide variety of domains. Some of these are telerobotic manipulators for hazardous waste removal, nuclear plant maintenance and repair, oceanographic sampling, remote surgery; for virtual reality applications in the entertainment industry, in medical training, training in the aerospace industry; for computer interfaces.

N95-095 TITLE: Man-Machine Interface to Integrated Mechanical Diagnostics Systems

OBJECTIVE: To provide a realtime view of mechanical system health in high stress operational and combat environments.

DESCRIPTION: As we transition our aging fleet into the 21st century, concerns for safety and affordability are in the forefront. Ships, aircraft, land combat vehicles and submarines will be operational well-past their planned service lives thereby introducing a new set of challenges for fleet operators and maintainers. Accordingly, both the Safety and Logistics Round Tables identified the transition to "Condition Based Maintenance" and the maturing of mechanical diagnostics technologies as their number one priority. Mechanical diagnostics technologies emerging from the Navy S&T community will allow onboard, realtime processing of data to accurately determine machinery health. These technologies will be available commercially in three to five years. Although information vital to safety and weapons system readiness will be generated by onboard processors, present man-machine interface technologies are not capable of providing usable information onboard, in realtime. To harness the enormous power of integrated mechanical diagnostics systems, new approaches to man machine interface need to be explored. U.S. Navy forward deployed and Marine Corps expeditionary force operations will depend on onboard processing to safely support the doctrine of Operational Maneuver from the Sea.

PHASE I: Contractor will develop a (COTS) helmet mounded display demonstrator capable of displaying video imagery, color graphics and symbology. Video displays must be upgradable to HDTV-standards as those technologies mature. Video in Phase I will be used for mission scenario demonstration purposes. Also in Phase I, the video capability will be used to demonstrate an embedded training capability and an electronic tech manual for field maintenance personnel. Contractor will coordinate with ONR/NAWC (TSD) to incorporate actual mission video, audio and diagnostics graphics and symbology to produce a proof of concept demonstration centered on an actual combat mission scenario for a Marine Corps H-46 (medium lift) helicopter. Contractor will demonstrate one example of a video electronic tech-manual on the HMD for (off-board) use by H-46 maintenance technicians and one example of how embedded training could be incorporated in the MMI-system.

PHASE II: H-46 Flight demonstration. Begin avionics systems integration (with diagnostics system provider) for interface to a government specified integrated mechanical diagnostics system. The flight system will be capable of fusing data from (at least) two separate diagnostics subsystems and display this information in realtime. Contractor will coordinate with NAWC (TSD) and NAVAIR to gain appropriate hardware and software certifications and flight clearances. Contractor will deliver a flight-ready MMI system within one year of the beginning of Phase II. The flight system will also incorporate limited embedded training and video electronic tech-manual capabilities for off-board use by H-46 maintenance technicians using the helmet mounted display while on aircraft main or auxiliary power.

PHASE III: Transitions of MMI-technologies include the entire Navy and Marine Corps helicopter fleet of approximately 1200 aircraft. An immediate transition opportunity may be the H-46 program where the Program Manager has voiced a desire for integrated diagnostics systems as part of a Service Life Extension Program (SLEP) for the H-46. Another immediate opportunity is the U.S. Army CH-47 Program that is now planning integrated diagnostics for that aircraft in a modernization program. The British MoD is also very interested in these technologies. No investment in onboard, realtime MMI is taking place in Europe. We anticipate that the contractor would team with the diagnostics system provider to incorporate MMI technologies as an integral part of a realtime, onboard integrated mechanical diagnostics system.

COMMERCIAL POTENTIAL: There is a vast commercial market for MMI technologies worldwide. New technologies are increasing the power of mechanical diagnostics systems while dramatically lowering the cost. As such, the commercial customer base becomes (nearly) open-ended. Whether helmet mounted, goggle mounted or flat panel displays, the new technologies emerging from this SBIR will be tremendously valuable to the performer. In the emerging market for the next generation of realtime mechanical diagnostics systems, MMI will be a multi-billion dollar industry. Customers: commercial autos, trucking, machine tool industry, railroads, oil/gas industry, commercial aviation (helicopter/fixed wing), auto/boat racing, nuclear power industry, commercial shipping, and machinery-intensive heavy industry

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1. Boff, K. R., Kaufman, L. and Thomas, J. P. (1986) Handbook of perception and human performance: Vol. 2, John Wiley & Sons: N.Y.

N95-096 TITLE: A Communication System for Analog and Digital Neural VLSI Microchips and Boards

OBJECTIVE: To develop a scalable communication system for neural event messages communicating between analog and digital neuromorphic VLSI chips and boards.

DESCRIPTION: The NAVY is developing analog VLSI sensors and pattern recognition systems in the acoustic and visual domains based upon neural network technology. Many applications will require the integration of multiple chips into tightly interacting subsystems where neural messages must travel from one chip to another or from one circuit board to another with proper accounting for message delays. Since analog neurons integrate signals in time, the communication system must not introduce latencies or variabilities that interfere with the neural integration mechanism. The goal of this SBIR is to develop a system that can 1) represent neural events taking place at a variety of sparse locations, 2) transport and route the event messages with adequate time representation, and 3) scale gracefully to very large multichip and multiboard systems using modular circuit board techniques with attention to size and power. Examples of this type of communication are the address-event, event-list and similar schemes proposed for action potential oriented neuromorphic analog VLSI. This SBIR work would allow efficient coupling and expansion of multiple address-event type pathways into a larger network of interacting neural network regions.

PHASE I: Develop communication protocols that generalize address-event and event-list schemes. Specify the hardware electrical and mechanical interface for a multiboard system. Demonstrate feasibility via a prototype of the system that has at least two neural network boards interacting over a backplane with central power distribution. Identify interface components best implemented in VLSI. Identify parameters that critically affect scalability.

PHASE II: Develop a complete demonstration system that integrates several neural network boards into a pattern recognition or control application while using both neuromorphic VLSI and classical digital neural network methods. Develop tools for system monitoring and performance measurement. Develop guidelines for deployment and for interfacing to existing NAVY electronic standards.

PHASE III: Productize the core components of the phase II demonstration hardware. Commercialize these items and seek industry standardization where merited. Develop and source custom VLSI support circuitry.

COMMERCIAL POTENTIAL: The core communication technology developed will conserve bandwidth and preserve timing relationships making it an enabling technology wherever neural networks are implemented in hardware that spans multiple chips or circuit boards.

REFERENCES:
1. Mead, C. Analog VLSI and Neural Systems, Addison Wesley, 1989.

N95-097 TITLE: Nonacoustic Sensors of Sliding Contact Mechanical Properties

OBJECTIVE: The detection of the state of mechanical "health" of a moving component, e.g., gear, bearing, or seal, is a major component in the growing field of condition based maintenance. Additional sensors of state variables, e.g., pressure, temperature, and chemical composition, must be embedded as integral components of moving parts and used as direct and early warning devices for mechanical failure. (We do not seek improvements or modifications of existing devices based
on acoustic or acceleration sensing.)

DESCRIPTION: Many problems associated with ageing military vehicles, e.g., trucks, tanks and aircraft, in particular, have to do with mechanical failure in critical elements. Rotor hub and transmission failures in certain helicopters, for example, have lead to a number of unfortunate fatal accidents. Past practice in maintenance is based on the cycle lifetime notion; vehicles and machinery are inspected on definite intervals and parts are replaced based on these inspections. The difficulty with this approach is that it does not work to detect many critical failures. In addition, the inspection process--requiring the dismantling of components--frequently introduces faults. The most tested approach makes use of acoustic sensors or accelerometers to detect adverse vibrations that arise and are associated with a failing component. The difficulty with condition-based maintenance has to do with (1) a general difficulty of knowing which mechanical elements are critical, and (2) the deconvolution of the acoustic signals received from various locations on the entire machine. Sliding solid contacts, such as gears and bearings, are difficult to investigate for the simple reason that it has proved difficult to insert appropriate probes into the interface. Some recent work has demonstrated that it is possible to insert thermocouples, pressure sensing devices, and even spectroscopic probes into the interface between two solid sliding contacts. Most current research obtains data on the conditions in the sliding contact--pressure, temperature, and chemical properties of lubricants.

PHASE I: Demonstrate that a new nonacoustic, nonaccelerometer in situ sensor can detect critical failure in a sliding contact sufficiently long before the actual failure occurs to be of use as a warning sensor. Such a demonstration can employ traditional scientific approaches, such as pin-on-disk measurements used in the study of friction and wear. However, the sensor must be an integral part of the sliding contact and cannot merely sense the state of a metal or other solid surface after emerging from contact.

PHASE II: Fabricate a working gear, bearing, or mechanical seal that incorporates the sensor or sensors and carry out tests to mechanical failure to demonstrate that the system works on actual components.

PHASE III: Initiate commercialization of the sensor in an appropriate system. The system can be a military machine (including weapon) or vehicle that is prone to critical mechanical failures.

COMMERCIAL POTENTIAL: There is a growing interest in condition based maintenance in the aerospace and automobile industries. In the civilian aerospace industry, for example, many of the problems that plague the military fleet also appear. Tight financial times have reduced the number of new airliners purchased and have greatly increased the necessary lifetime of the existing fleet. Retrofitting aircraft with critical element and critical failure sensors--as faults are detected--will greatly increase the lifetime of the aircraft, greatly increase the safety margin, and greatly reduce the overall operating costs. In the automobile industry, similar concerns for safety and economy of operation arise.

REFERENCES:

1. A. M. Williams, Y. Jiang and D. Ben-Amotz, chem. Phys. 180, 119-130 (1994): Chem. Phys., 183, 385 (1994)
2. P. D. Horak and U. J. Gibson, Appl. Phys. Lett., 65, 968 (1994)

N95-098 TITLE: Ductile-to-Brittle Transition in Molybdenum Disilicide ($MoSi_2$) and Related Materials

OBJECTIVE: Improve ductile-brittle-transition temperature (DBTT) theoretically (via modelling) and experimentally (via microalloying, for example) in order to provide materials for advanced fighter jet engine parts, such as blades, disks and vanes.

DESCRIPTION: $MoSi_2$ possesses almost all the attributes needed in a very high temperature structural material with use temperatures exceeding 1000^0C. The only drawback of $MoSi_2$ is its low ductility at low temperatures (<500_0C). At present, the DBTT of $MoSi_2$ is about 1000^0C, and it must be lowered to under 500^0C to exploit its full potential without sacrificing its high temperature creep and oxidation properties. In light of related efforts, efforts should focus on microalloying with elements to "ductilize" and toughen $MoSi_2$ intrinsically, permitting economical composition and convenient testing (as a monolithic material). (The addition of a second phase, such as SiC_p or SiC_w, is not to be considered.)

PHASE I: Theoretical analysis, perhaps by first principals and/or ternary and higher phase diagrams (verified by mechanical and metallurgical characterization).

PHASE II: Extension of approaches to produce larger samples of a family of promising "alloys" with and without particulate or whisker additions (e.g., SiC or Si_3N_4).

PHASE III: Develop manufacturing methods for jet engine or other propulsion system components with a prime contractor(s).

COMMERCIAL POTENTIAL: The market for a ductile and tough $MoSi_2$ is very large. Conventional $MoSi_2$ is presently used for heating elements in an oxidizing environment for >1200^0C service. Once the problem of toughness, or lack of it, is solved, markets for the material will undoubtedly open up for uses more mundane than that of high temperature heating elements.

N95-099 TITLE: Spatial Geometric Analysis Systems

OBJECTIVE: Develop enabling technology that will enhance the capability to apply constraint-based techniques to spatial geometric applications in mechanical engineering design.

DESCRIPTION: Constraint-based solvers offer an important approach to solving complex geometric problems that often arise in mechanical design. Unfortunately there is limited experience with this technology outside a few research groups. It is important to support development of such software tools that are robust and compatible with a few of the major commercial CAD systems and that provide functionality not currently available in existing commercial systems.

Current tools are often limited range of applicability and robustness and are not well integrated with symbolic-numeric geometric data representations. The long-range goal is to create a high-level, customizable, portable, constraint-based spatial geometric solver tailored to CAD applications as arising in the areas of mechanical and assembly design. A near-term objective is to develop a spatial geometric constraint solver with the properties that it (1) does not require that constraints be satisfied in a fixed order, (2) solves a broad class of spatial problems, (3) is computationally efficient, (4) locates solutions when initial problem specification places the shape elements far from their final position, (5) provides for finding alternative solutions, and (6) is interoperable with several commercial CAD systems.

PHASE I: Develop required mathematical techniques and demonstrate a software prototype that demonstrates a important features of a geometric constraint solver. Develop a software design, a clear mathematical justification of its viability, and a software development plan to build a fully functional prototype realizing the above goals.

PHASE II: Develop and validate a fully functional prototype and that is interoperable with several commercial CAD systems. The validation must include realistic constraint problems arising from designs of equipment used by the Navy.

PHASE III: Potential follow-on efforts are expected in Naval ship design and production organizations, on civil engineering activities on government projects, and generally on the design of equipment used by the government.

COMMERCIAL POTENTIAL: A credible solution of the problem can be marketed to all major CAD vendors and many vendors dealing with robotics, major industry including aerospace, shipbuilding, and automotive.

REFERENCES:

1. D. Blackmore and M.C. Leu, Analysis of Swept Volume via Lie Groups and Differential Equations, International Journal of Robotics Research, Vol. 11, No. 6, 1992, pp. 516-537.
2. B. Bruderlin, Using geometric rewrite rules for solving geometric problems symbolically, Theoretical Computer Science, 116:291--303, 1993.
3. G. Crippen and T. Havel, Distance geometry and molecular conformation, John Wiley & Sons, 1988.
4. E. J. Haug, editor, Computer aided analysis and optimization of mechanical system dynamics, Springer-Verlag, 1984.
5. C. Hoffmann, On the semantics of generative geometry representations, In Proc. 19th ASME Design Automation Conference, pages 411-420, 1993.

N95-100 TITLE: Digital Assistant Technology

OBJECTIVE: Develop a prototype of a wearable conformable personal digital assistant for mobile and fixed-based work tasks.

DESCRIPTION: Personal digital assistant (PDA) technology extend conventional information infrastructure and technologies of local area networks (LANs) and computers into a flexible mobile setting. This evolution is evident from the emergence into the commercial marketplace of laptop computers, personal digital appointment notebook computers, and "anywhere" telephone numbers. Problems with PDAs arise from lack of a mobile digital infrastructure (e.g., differing from a conventional LAN), inadequate access in real-time to other computing resources (e.g. limited bandwidth obviated image file transfer), fragility and size of equipment, power management problems, and awkward human-computer interfaces for mobile work activities (e.g. typeboard/ mouse interface may be inappropriate for some tasks). The form and function of current PDAs can often be at odds with mobile tasks and the range of tasks to which they need to be applied. Designs must address general issues raised in the above description, issues of manufacturability and affordability of production, and be justified scientifically and technologically. The PDA environment should focus on applications to industrial/laboratory equipment maintenance and instructional classroom settings, involving several different human-computer interfaces and a wireless, adaptive, and mobile infrastructure for PDA operation.

PHASE I: Design an innovative form and function PDA and associated infrastructure from commercial off the shelf (COTS) technologies and from among emerging innovative technologies (e.g., micro-electro-mechanical systems, battery technologies, voice recognition, solid-freeform fabrication, etc...).

PHASE II: Develop and validate a fully functional prototype. Demonstrate the prototype on a realistic Navy relevant training task for equipment monitoring and maintenance.

PHASE III: Potential follow-on efforts are expected in education and training, and in important equipment repair and maintenance tasks of government equipment.

DUAL-USE: PDAs will enable current fixed based activities to become mobile as needed. This will have a profound impact on education, and training. This concept can enable lesser-trained technicians to accomplish more complex tasks because they will have access to the information and knowledge of senior engineers where and when it is needed via PDAs.

COMMERCIAL POTENTIAL: A credible solution of the problem can be marketed by major OEM and other vendors dealing with software and hardware. In particular important commercialization potential is expected in major industries including aerospace, shipbuilding and repair, and automotive.

REFERENCES:

1. The current commercial PDAs include the Apple Newton or Sharp PDA. ONR and ARPA R&D investments in electronics, micro-electronic-mechanical systems, communications, and manufacturing technologies may provide capabilities to reduce size, weight, flexibility and power consumption and to increase computational capability and range of functionality. An FY95 ARPA initiative in "tactical information assistants" is complementary to this proposed topical area.

N95-101 TITLE: Solid Free-form Fabrication

OBJECTIVE: Advance the technology and manufacturing processes for solid free-form fabrication.

DESCRIPTION: Current solid free-form fabrication processes have proven their potential for many engineering and medical applications. Conceptualization models, fit check prototypes, manufacturability assessment artifacts, and prosthetics are examples of successful applications of these new technologies. The technological challenges include fabrication of larger parts, faster processing, increased part accuracy, and utilization of new materials that expand the range of functional parts fabricated using these processes. To meet these challenges will demand coordinated R&D efforts in many areas including (e.g.) materials, structures, rugged micro-electro-mechanical sensors and precision actuators, continuous in-situ process monitoring and control, computer aided processing, spray or deposition technology, and laser optics.

PHASE I: Identify and develop a technological advancement in an SFF processing. Justify the basis for the proposed advancement from considerations of scientific, technical, manufacturability, and affordability issues. Define project milestones and participant responsibilities, including partnership consortium descriptions if necessary.

PHASE II: Develop a functional prototype of the proposed technology in an operational SFF system. Demonstrate the capability of the system through the construction of a functionally gradient part of significant design and manufacturability complexity.

PHASE III: Transition to government activities involving design, modeling, rapid prototyping, production, and maintenance of equipment.

COMMERCIAL POTENTIAL: Several companies have recently been formed along the major competing SFF technologies. The technology offers the capability for the rapid production of complex custom parts and part models, which can significantly reduce the time and total cost for part development. In addition the creation of SFF service bureaus,accessible via electronic communications networks, offers potential capability to do remote, distributed design and manufacturing. As part size, accuracy, fabrication speed, and functional application increase and as the need for customized and specialty parts increases, demand for the technology will increase dramatically.

REFERENCES:

1. Proceedings of the Solid Freeform Fabrication Symposium, The University of Texas at Austin (1992, 1993, 1994).

2. Jacobs, P. F., Rapid Prototyping and Manufacturing, Society of Manufacturing Engineering Publications, Dearborn, MI, 1992.
3. Burns, M., Automated Fabrication: Improving Productivity in Manufacturing, PTR Prentice Hall, Englewood Cliffs, NJ, 1993.

MARINE CORPS

N95-102 TITLE: Lightweight Surveillance Radar Technology

OBJECTIVE: To provide technology, simulations, and prototype development for a miniaturized air/ground multi-mode surveillance radar.

DESCRIPTION: The end objective which this topic supports is to develop a miniature surveillance radar, including the antenna system, power supply system, and communications down link, small and light enough to fit into an Unmanned Aerial Vehicle (UAV). The UAV would be used to support airborne early warning (AEW), ground mapping, ground movement detection, and other missions through the use of a variety of in-flight, programmable scan and reporting modes. Data from the UAV-based radar system would be down-linked to a ground based command and control system. Advances in miniaturized solid state radar design, antenna technology, low power electronics, and UAV technology are all potential contributors to this effort. A currently produced UAV could be adapted to this mission, or a new UAV developed.

PHASE I: Perform preliminary design activities, modeling, and/or demonstrations for a miniaturized, multi-mode, radar system or for critical system components. Use Computer Aided Design and Modeling (CAD/CAM) as appropriate to provide preliminary estimates for radar and UAV platform performance.

PHASE II: Continue design activities for the radar system and/or for critical system components. Provide prototype demonstrations and/or detailed system level models. Detail the performance which could be achieved by a completed UAV-based radar system. Refine cost and schedule estimates.

COMMERCIAL POTENTIAL: The technology developed would have wide commercial application in areas involving radars for law enforcement, terrain mapping, environmental monitoring, and other areas. Variations of the completed UAV system could be used for traffic surveillance, drug interdiction, and radar-mapping.

N95-103 TITLE: Low Cost, High Waterspeed Obstacle Detection System

OBJECTIVE: To develop a low cost obstacle detection device that will be mounted on a surface vehicle travelling over water at high speed that is capable of detecting submerged objects.

DESCRIPTION: Current sonar and acoustic devices for detection of underwater and sub-surface obstacle are bulky, heavy, and expensive. Military versions are expensive and not easily mountable on small craft. Current commercial systems do not have adequate range or work at vehicle speeds over water at greater than 20 knots. This obstacle detection system shall include detection devices, processor, and operator display. This system shall be capable of discriminating objects as small as 20 pounds in mass and one cubic foot in volume at ranges between 100 and 400 meters from the craft. A 15 degree angle of inclusion shall be provided and a refresh rate of 2.5 cycles per second or greater is desired. The system that extends into or interfaces with the water shall be as small as possible so as not to provide unnecessary hydrodynamic drag, but must be able to operate close to the surface and be non-sensitive to spray and surface generated noise or disturbances. Operator feedback via a display or readout is required to be done in realtime mode.

PHASE I: The contractor shall perform trade-off and requirements analysis, followed by a detailed mechanical and electrical design for an obstacle detection system capable of being mounted on a flat bottom planing hull craft. Under this phase of the program, the contractor shall provide monthly progress reports, a commercial marketing plan, a final design report, and preliminary concept and layout drawings. The contractor shall host two meetings at his facility for government review (start of work and mid-review) and shall provide a final review to the

Government at a Government site. An option to this phase which shall be included with the phase I proposal shall be preparation of detailed fabrication drawings and a breadboard demonstration (in the laboratory or in the field) of the highest risk technical aspect of the system.

PHASE II: The contractor fabricate and deliver one complete system of the obstacle detection device suitable for proof of concept demonstration on a planing hull craft. The contractor shall host status review meetings at his facility approximately every three months. Delivery of hardware, to take place after internal contractor testing, shall be 18 months after start of phase II effort. A fabrication report to include contractor test plans and test data and as-built drawings shall be delivered within 20 months after start of phase II efforts.

PHASE III: The contractor shall update the obstacle detection system based on contractor and government test results and shall deliver a ruggedized, second generation system suitable for vehicle testing. A development and fabrication report shall be delivered with the system within 9 months after start of phase III efforts.

COMMERCIAL POTENTIAL: A cost effective obstacle detection system for high speed craft will be of benefit to the pleasure boating and work boat industries that currently rely on sailor experience to avoid possible grounding of craft. High speed, small ferry operations that can not afford military grade sonar systems currently rely on observers to keep craft out of danger, but submerged obstacles are difficult to see in varied daytime/nighttime and different light conditions.

N95-104 TITLE: Portable Environmental Control System (PECS)

OBJECTIVE: To explore new endothermic (heat absorbing) materials for use as cooling media to Navy/Marine personnel in hot, humid environments and as a thermal heating source to personnel in cold environments; To design, develop, and fabricate PECS hardware for laboratory testing, field evaluation, and commercial marketing.

DESCRIPTION: Navy/Marine personnel are exposed to extreme hot and cold environments while performing their duties. Presently, the military inventory must stock separate gear for each condition. Endothermic materials research will be applied to the problem of climate control for military personnel. A single lightweight garment material is desired, working as both a radiating material in hot weather and an insulating material in cold weather.

PHASE I: The contractor shall conduct a search of all data and information on the needs and requirements for microclimate cooling (MCC) and heating for Navy/Marine personnel in order to develop thermodynamic guidelines for potential endothermic agent(s) to be used as the active component(s) in the environmental control system. The contractor shall select and characterize the most suitable endothermic agents for inclusion in a demonstration system prototype. After a thorough thermodynamic evaluation of the agents, the contractor shall design and fabricate a feasibility demonstration prototype for test and evaluation.

PHASE II: Using the research, development, design, and fabrication initiatives from the prototype development effort, the contractor shall extend the scope of the program to optimizing the configuration for PECS development for both cooling and heating utility. Selection and tailoring of the endothermic agent(s) will be based on the results of test and evaluation of the demonstration prototype. The prototype hardware configuration (a garment design or other) shall be optimized for maximum wearer comfort and thermodynamic utility, while requiring minimum logistic supportability. The product of this phase of the development effort shall exhibit not only an attractiveness to the combat sailor/ Marine, but also demonstrate an attractiveness to the commercial market. Commercial applications shall be identified, and product test samples shall be made available for evaluation by potential users.

PHASE III: Commercialization of the Phase II systems shall be given widest dissemination and exploitation. Market surveys commencing during the Phase II effort shall be completed. Scale-up processes from a preproduction mode to full production of PECS shall be identified and commence as the final transition from combat development to commercial application is made. The end product of this R&D program will provide off-the-shelf commodities for procurement by the military and civilian markets.

COMMERCIAL POTENTIAL: Limited research & development (R&D) into endothermic, phase change transition materials has demonstrated a potential for keeping foods warm for extended periods of time. These materials, having very high thermal capacity and thermodynamic properties (extremely high heats of fusion and specific heat), have already been incorporated into cups, bags, food carts, trays, and related devices. Some commercialization of the technology has already begun, as Pizza Hut, for example, is now using a special tray and heating disk made from these high tech endothermic materials for their delivery service. These disks have demonstrated the ability to maintain a 2-4 pound pizza above 140°F for 90 minutes. Although these endothermic materials have high potential for use in hot water heaters, camping gear, cold weather clothing, boots, fire control applications, and the like, no funding efforts have commenced in these areas. Because these materials are "heat absorbing", undergarments impregnated with endothermic agents could essentially extract excess body heat, exhaust such heat to the external environment, and keep the wearer cooler for extended periods of time. Firefighters, race car drivers, and wearers of protective clothing (nuclear and chemical workers, for example) could substantially benefit from these endothermic materials. In cold temperature environments, the heat absorbed from the body by these materials could be prevented from being exhausted and therefore maintain the body's temperature for a longer period of time. Skiers, skaters, oil pipeline workers, and the like could take maximum advantage of this technology in the heating mode.

REFERENCES:
1. "Answer Looking for a Problem" (Ballistic Missile Defense Office technology development), AVIATION WEEK AND TECHNOLOGY, Vol. 15, June 13, 1994.
2. "A Star Wars Legacy: Hot Pizza", BUSINESS WEEK, Vol. 81, January 17, 1994.
3. "Composite Fabrics Spruce up the Heat Sink", OUTLOOK, July 2, 1984
4. US Patent 4,446,916, "Composite Fabric Endothermic Electronic Component Cooling", May 8, 1984

N95-105 TITLE: High Temperature Corrosion Resistant Coatings

OBJECTIVE: To develop a low cost coating that provides increased corrosion resistance for application on components operating in high temperature environments such as engines and exhaust systems.

DESCRIPTION: The United States Marine Corps has identified corrosion as an ongoing problem area. Higher life cycle costs of equipment, reduced operational availability, and excessive manpower requirements to maintain operability are some of the problems associated with corrosion. Current corrosion control methods, as well as some aspects of weapon system designs, have been identified as Naval requirements. Recent surveys of fleet vehicles have targeted several areas requiring the conduct of research and development of new corrosion resistant materials, coatings and procedures to prevent and combat corrosion problems. One persistent problem found repeatedly throughout the investigation was the general corrosion, pitting and crevice corrosion found on several vehicles' engine and exhaust systems. Typical applications to be targeted include engine exhaust manifolds, exhaust pipes, mufflers, and protective screening. These areas of the vehicle are exposed to severe environments where coatings often fail. Consequently, heavy amounts of corrosion can be found in these areas where coatings either fail or are never applied necessitating the need for a more extensive and durable coating. Exhaust components can experience temperatures as hot as 800^{o}C (1,475^{o} F) adjacent to the engine. Components further along the exhaust system experience 200^{o} C temperatures.

PHASE I: The contractor shall perform research efforts toward developing low cost, corrosion resistant coating that can be applied to components and systems operating in high temperature environments. At a minimum, laboratory experiments shall be conducted during this phase to demonstrate the effectiveness of the coating(s) to withstand high temperatures. The contractor shall host two (2) meetings, a kick-off and mid-term review, at his facility for government personnel. The contractor shall provide a Final Report and final review briefing at the completion of the phase at a government site to be determined.

PHASE II: The contractor shall perform full-scale application and demonstration of the high temperature coating(s) on an actual piece of military equipment supplied as Government Furnished Equipment (GFE). Application techniques shall be determined and demonstrated through experimentation. Testing of the sample component(s) shall be conducted in the laboratory under actual environmental conditions including temperature, humidity, salinity, and exposure to the sun. The contractor shall host status review meetings at his facility approximately every three months throughout the performance period. A Final Report and final review briefing shall delivered at the completion of this phase.

PHASE III: The contractor shall apply the developed coating(s) on six (6) pieces of military equipment (GFE) for extensive field testing to determine the operational suitability of the coatings as they relate to performance, durability and maintainability.

COMMERCIAL POTENTIAL: A cost effective coating that can be applied to components that operate in high temperature environments, that resists corrosion, and that withstands normal wear and tear typically experienced in military applications has enormous potential for the commercial automotive industry. Auto makers, truck manufacturers and producers of marine equipment can benefit from this technology. High precision turbine engine, diesel engine and air compressor manufactures can also benefit. Any application where high temperatures are experienced and dependable coatings are required would gain from this technology.

REFERENCES:
1. Corrosion of Combat and Tactical Equipment on US Marine Corps Bases, CARDIVNSWC-TR-61-94/19

N95-106 TITLE: Radio Frequency Information Dissemination

OBJECTIVE: Develop wireless displays and internet compatible transfer of Radio Frequency (RF) tag information through open communication standards.

DESCRIPTION: Military logistics information systems are being developed using RF tagging technologies. The amount of information being disseminated will require advanced communication systems to interface with existing systems and a sophisticated architecture to handle the information volume.

PHASE I: The contractor shall identify Internet and other transmission and messaging standards for RF communication to low-cost battery-operated tags with built in two-way communication. The study shall compare protocols, connection and messaging capabilities. The study will address throughput. Information transmission may include inventory data as well as video display for field asset location. The architecture will provide deployed theater users with access to RF information.

PHASE II: The contractor shall prepare a brass-board concept feasibility model and demonstration. It shall demonstrate open RF transmission protocols between tags and interrogators, and remote heads-up displays. Volume data handling will be demonstrated.

PHASE III: The contractor shall prepare a system for suitable testing on a large scale. Transmission protocols will communicate with tens to thousands of tags present within range, while interfacing the information to a variety of identified military systems. Transition will include commercially available system integration components.

COMMERCIAL POTENTIAL: The RF tag which interfaces to large information volume applications will be a benefit to the medical, manufacturing, transportation, and maintenance fields. Item control within wireless local and wide area networks will greatly increase the user ability. Tags will be compatible with the National Information Infrastructure initiatives.

REFERENCES:
1. MIL-STDs 1780, 181, 1782
2. FIPS PUB 1461-1
3. RFCs 1122, 1123, 822

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N95-107 TITLE: Data Link Training and Exercise Coupler

OBJECTIVE: Design and develop a low cost device to couple RF band data link systems via phone lines for use in training, exercise, testing, and development.

DESCRIPTION: Tactical data links use wireless radio communications to connect terminals on land, ships and aircraft. For purposes of training, exercise, testing, development, and potential operational uses it is valuable to be able to link an RF band system, including the host computers served by the terminal, to similar systems at various remote locations around the country or the world. Rather than link systems at such distances by radio frequencies (RF), the proposed coupler would connect to the terminal by coax or fiber at RF, maintaining the high signal to noise ratio. It shall reduce the message traffic to baseband which can be carried over phone lines and connected to similar configurations anywhere in the world. Information describing simulated environments can also be shared via phone lines so that the participating systems seem to be operating together in a common tactical area.

PHASE I: Perform the studies necessary to define design alternatives of a Coupler and develop a preliminary design. The Coupler should be capable of supporting Link 16 fixed format messages. The controlling computer component of the Coupler should be a commercially available microcomputer, preferably an IBM compatible machine. In addition to the radio frequency (RF) interface the Coupler should have a standard serial interface (probably RS-232) over which it will forward data received from the RF interface and will receive data for transmission on the RF interface.

PHASE II: Produce an Advanced Development Model of the Link 16 Training and Exercise Coupler. Demonstrate its functionality by installing and testing the terminal at the Navy's Link 16 Systems Integration Facility (SIF).

PHASE III: The Coupler design will be refined to make it convenient and flexible to use for many military and commercial applications. Cooperative development support will be sought within the Department of Defense and with other interested nations.

COMMERCIAL POTENTIAL: The coupler has applicability to other RF systems for similar long distance test, simulation and training.

N95-108 TITLE: Quantification of Platform Level Mission Effectiveness

OBJECTIVE: To devise a methodology and develop a model for quantifying electromagnetic system degradation effects on platform level mission effectiveness.

DESCRIPTION: In recent years, the Navy's Ship Survivability Program developed generic component, system, and platform level deactivation models for use in identifying and prioritizing system and platform vulnerability to specific hard kill threats. These models can be expanded and applied to Battle Force simulators to take into account degradation of systems resulting from EMI, and thus meet the important goal of quantifying platform mission effectiveness. Historically, weapon systems have been assessed individually in terms of degradation of performance without regard to platform level mission effectiveness. The need to develop this assessment capability is supported by the aircraft and ship acquisition and operational communities.

PHASE I: To demonstrate feasibility, the basic approach is to, (a) review existing procedures, practices, and models for applicability, and (b) develop, modify, and apply a prototype model to a specific platform application, and (c) demonstrate satisfactory technical results based upon technical and operational experience.

PHASE II: Integrate the developed Platform Mission Effectiveness model into an existing Battle Force simulator and perform technical and operational assessments and validation checks based upon established operationally accepted Measure of Effectiveness (MOE), for a specific ship.

PHASE III: Standardize these methods for applications in commercial navigation and aircraft control.

COMMERCIAL POTENTIAL: Degradation to the Federal Aviation Administration's (FAA) air traffic control system could be modeled using this proposed methodology. This modeling will be particularly important when the new Aircraft Automated System (AAS) is brought on line. The potential threat with respect to air traffic control are conventional and directed energy terrorist weapons.

N95-109 TITLE:Milstar MDR - Network Bridge

OBJECTIVE: Develop protocols for bridging and multiplexing EHF MDR terminals with advanced networks.

DESCRIPTION: Investigate, develop and demonstrate efficient algorithms and protocols to multiplex and interface EHF MDR terminals to advanced networks (such as Asynchronous Transfer Mode/Synchronous Optical Network systems) thereby providing EHF terminal user's access to medical imagery, photography, and fixed site locations while maintaining system security.

PHASE I: Develop the algorithms needed to efficiently bridge and multiplex Milstar MDR terminals with a packet switched network.

PHASE II: Code and demonstrate algorithms using commercial hardware needed for the MDR/ATM interface.

PHASE III: Build and demonstrate the complete interface.

COMMERCIAL POTENTIAL: Protocols can be used for connecting other digital satellite systems (e.g., Iridium) with advanced networks.

REFERENCES:
1. MIL-STD-1582C, "Satellite Data Link Standards: Uplinks and Downlinks" 10 Dec 91.
2. MIL-STD-188-136, (coordination draft), "Satellite Data Link Standards, Medium Data Rate (MDR), Uplinks and Downlinks" 07 Mar 94.

N95-110 TITLE:Demodulation of Signals Localized by Super-resolution Array Processing Techniques

OBJECTIVE: Explore signal processing techniques which permit reconstructions of signals decomposed by super-resolution array processing techniques.

DESCRIPTION: In a dense signal environment, co-channel interference occurs when two communication signals transmit simultaneously in the same segment of the frequency spectrum. Intentional jamming of radar or communication signals also represents an example of co-channel interference. The use of arrays of antennas to direct radiation pattern nulls provides one approach to the rejection of interferers. When the direction of arrival of an interfering signal is very close to the direction of arrival of a signal of interest (e.g., beamwidths) super-resolution techniques provide means of distinguishing between signals. Unfortunately, most super-resolution techniques discard phase information necessary to demodulate communication signals. Means of separating and demodulating closely spaced signals is of interest.

PHASE I: Identify candidate approaches for separating and demodulating signals transmitted by closely spaced co-channel emitters. Possible approaches may include, but are not limited to, extraction from original, unprocessed data of phase information for signals distinguished by super-resolution; cyclo-stationary approaches to array and signal processing; or array processing techniques employing higher order statistics.

PHASE II: Implement and, using realistic simulations, demonstrate best approach(es). Evaluate approach(es) with regard to computational intensity, spatial resolution and quality of demodulated desired signal (e.g. bit error rate).

PHASE III: Apply array processing technology to appropriate communication systems.

COMMERCIAL POTENTIAL: Interference rejection presents an important challenge to the burgeoning cellular telephone industry.

REFERENCES:
1. Freeman, Roger L., "Telecommunication Transmission Handbook, Third Edition", John Wiley & Sons, Inc., 1991.

N95-111 TITLE:Multiple, High Bandwidth Light Weight Satellite Communications (SATCOM) Antenna

OBJECTIVE: Development of a small, light weight multiple band phased array high bandwidth satellite antenna system capable of operating in the UHF, C and Ku bands, SHF and EHF frequency ranges. Dual to multiple band operation is desired. The antenna system is for shipboard use and Very Small Satellite Access Terminal (VSAT) computer communications from small ships and planes.

DESCRIPTION: NRL currently has an ocean buoy system capable of transmitting/receiving data, via commercial satellites operating in the C & Ku bands, to one or more land sites at data rates in excess of 1.5Mb/s. To accomplish this, the buoy currently uses a parabolic dish antenna system 1.2m in diameter. This relatively large size limits deployment opportunities. Miniaturization technology could be employed to reduce antenna size to perhaps as little as 100 square cm, allowing the system to be easily air deployable and deployable from small ships while still operating in the current frequency ranges.

PHASE I: Develop the basics of a phased array antenna system able to operate within the constraints described above.

PHASE II: Develop a prototype antenna to demonstrate the capabilities, size limitations, and bandwidths of phases array technology.

PHASE III: Produce a phased array antenna capable of withstanding the rigors and requirements of at-sea deployments on ships or buoy systems.

COMMERCIAL POTENTIAL: Development of this capability could expand the portable communications market by making worldwide high bandwidth communication possible.

N95-112 TITLE: Graphic CASE Tools for INFOSEC Threat and Risk Analysis

OBJECTIVE: To permit security requirements and associated threats and risks for Navy C4I systems to be quickly captured and displayed during initial sponsor/developer/accreditor negotiations.

DESCRIPTION: Existing CASE tools for INFOSEC risk analysis are designed for trained certifiers and are generally not suitable for initial high-level (non-jargon) evaluation of system security approaches. However, designing new CASE tools to meet this need appears prohibitively expensive and time-consuming. The Navy would like to explore the adaptation of existing (non-INFOSEC) CASE tools with good graphical system display capabilities and expert system shells to be effective trade-off and negotiation vehicles.

CASE tools for INFOSEC threat analysis do not exist, and available threat information is disjoint and extremely difficult to use by either trained certifiers or by high-level decision makers. An initial Navy effort, begun in FY 94, has an objective of building a prototype Tailored Threat Profile tool. That tool will contain a database of actual attacks against Navy systems (or analogous systems). When queried, the tool will ask for high-level descriptive data about the proposed system and then return a profile of likely threat scenarios. However, the prototype system will not show a graphical description of the proposed system nor use an expert system shell to reason about likely threat scenarios. The Navy would like to explore the adaptation of existing (non-INFOSEC) CASE tools with good graphical system display capabilities and expert system shells to build a follow-on to the initial prototype.

Modified CASE tools for INFOSEC threat and risk analysis are needed that will capture and display:

a. the system itself with major subsystems and components;
b. the environment that the system operates within;
c. the importance of the system and the information it handles;
d. interfaces to the system (both human and otherwise) with some indication of their trustworthiness;
e. potential threat scenarios; and
f. assumptions and assertions about the existence of INFOSEC protective features (either in the system or in the operating environment).

The output of the INFOSEC threat tool will be a graphical view of the system showing the most likely (if any) threat scenarios. The output of the INFOSEC risk analysis tool will be a graphical view of the system showing the agreed-to set of system and environmental protective features that represents the negotiated INFOSEC approach (ie. acceptable risk, acceptable cost, acceptable program/technical implications).

PHASE I: Define problem, select and demonstrate existing CASE tools, scope and plan required modifications.

PHASE II: Accomplish and demonstrate modified tools suitable for Navy C4I systems. Support government beta testing. Modify tools as appropriate.

PHASE III: Expand tool libraries beyond initial C4I capability. Produce tools as commercial products.

COMMERCIAL POTENTIAL: These analysis tools would prove very useful for non-defense commercial organizations, especially in the financial and medical industries where disclosure, modification, or destruction of sensitive information could cause a great amount of damage. These tools would help such organizations to identify potential threats and risks to their information assets and address them appropriately.

N95-113   TITLE: Coarse-Grained Parallel Desktop Computing System for Enhanced Image Processing

OBJECTIVE: Development of a high performance, coarse-grained parallel workstation to process sensor data.

DESCRIPTION: Desktop computer workstations are sought that contain 4 to 16 CPUs capable of operating in parallel and providing multiple GigaFLOP performance for image processing applications. These CPUs should also possess large associated internal memories to support the processing of large sections of individual images. Very large data storage systems with capacities in excess of 10 Gigabytes are desired for image processing applications. These systems must have data access times and transfer rates that meet or exceed current desktop computer hard disk specifications. The integration of memory devices such as PC-MCIAs for transferability and security into memory is desired. New visualization techniques are sought for the optimal presentation of the 2-D and 3-D transformed images resulting from the advanced signal and image processing algorithms. An integrated Operator Machine Interface (OMI) is desired that links features automatically detected in the transformed images back to specific features in the original images. This MOMI should be sufficiently generic so that imagery of various types ranging from X-ray to satellite images can be displayed at appropriate resolutions. The capability of simultaneously displaying multiple resolution screens (hyper color) is required. Workstations of this type will have many possible defense and commercial applications in areas such as automated screening of medical or satellite imagery.

PHASE I: Design a scale able, coarse-grained parallel computer workstation architecture capable of at least two GigaFLOPS of performance and having at least 0.5 Gigabytes of RAM. An integrated OMI design complete with associated documentation. A limited demonstration involving two different types of images (X-ray, MRI, etc.) combined with associated images resulting from two or more signal or image transformations of interest is also required at the completion of Phase I. Document this design and demonstrate a prototype at the completion of Phase I.

PHASE II: Extend the Phase I design to produce an enhanced version with at least 20 GigaFLOPS, 2 Gigabytes of RAM, and the ability to store 500 one byte 8" X 10" images with a resolution of 500 pixels per inch. Image processing at 1/8 real time is required. Real time processing is desired. Implementation the Phase I OMI design on a designated coarse-grained parallel computer system and extend the number of image types handled to a minimum of six, based on government provided data sets.

PHASE III: Transition this technology to appropriate defense and commercial sensor data collection, sensor data analysis, and sensor communications applications.

COMMERCIAL POTENTIAL: The primary commercial applications of this technology are in automatic rapid computing for mass screening of medical images for conditions requiring physician follow up and automatic rapid computing for material flaws (non-human screening) in mass produced items (i.e. non-destructive testing).

REFERENCES:
1. Digital Image Processing, by Raphael C. Gonzalez and Riochard E. Woods, Addision-Wesley, 1992.
2. Illumination and Color in Computer Generated Imagery by Roy Hall, Springer-Verlag, 1988.
3. Computer Graphics: Principles and Practice, by James D. Foley, Andries Van Dam, Steven K. Feiner, and John F. Hughes, Addison-Wesley, 1990.
4. Deans, Stanley R., *The Radon Transform and Some of Its Applications,* rev. ed., 1993, Krieger.
5. Bracewell, R. N., *The Fourier Transform and Its Applications,* 2nd rev. ed., 1986, McGraw.

N95-114   TITLE: Virtual Information Model (VIM)

OBJECTIVE: To adapt emerging video, message and model-modifying techniques for the exchange of hybrid data over existing land and satellite links to and from fleet units. This initiative will unburden the need for bandwidth by transferring only previously unknown data: simple, clear, accurate and timely descriptions of complex changing situations and environments could be exchanged without the consequences of voluminous and overloading data streams.

DESCRIPTION: This task will develop a prototype system optimizing an amalgam of commercial video formats and protocol, Defense Mapping Agency derived models, supplying movable windows with zoomable video, audio and data panes, and operational message formats. The fundamental feature sought is the transfer of hybrid change information of an operational scene (depicted by structured video images, audio transmissions and operational message traffic) to a remote system containing the same initial structure but requiring change data to remain identical. This schema would enable short, quick packets of data in real time to reduce overall traffic demands and use low point-to-point bandwidth.

PHASE I: Conduct a trade-off analysis of existing or low-risk emerging techniques. Insert higher risk techniques with innovative risk reducers into the analysis for optimizing payoff. Provide a short demonstration using PC to PC remote connection, CD-ROM resident scenarios (15 to 30 minutes) with externally selected naval engagement overlays. Proposer may offer an alternative means of demonstration. Apply metrics to compare traditional and model-modifying techniques.

PHASE II: Implement a sender-to-user workstation environment based on the video/audio/message structures designed in Phase I for an initial evaluation at a Navy facility such as Naval Command Control and Ocean Surveillance Center (NCCOSC). Introduce one or more commercially viable scenarios. Stress the model to bandwidth and complexity limits.

PHASE III: The successful use of modelling would lead to low-cost interim pathways pending the implementation of the anticipated "super-highways" connecting global networks. Applications for the telecommunications industry are myriad.

COMMERCIAL POTENTIAL: It is anticipated that this approach will become as profound a capability commercially as militarily, a "force multiplier" for more advanced data links in future, capturing multiple and user-controlled data panes. The technique would be applicable to tactical links, command and control summaries, traffic control, situation displays, and both military and commercial global surveillance (geological, agricultural).

REFERENCES:
1. IEEE Spectrum, March 1992.

N95-115 TITLE: Expert System Tactics Representation

OBJECTIVE: Develop reusable, object oriented, expert system software capable of capturing the human tactical decision processes associated with the employment of Naval platforms, sensors and weapon systems, and reproducing them within campaign and engagement level discrete event warfare simulations.

DESCRIPTION: Current campaign and engagement level discrete event warfare simulations generally represent the tactical decision processes associated with the employment of platforms, sensors and weapon systems in manners that are highly dependent on both the simulation system and the scenario. Frequently the decision processes are fully scripted or are represented by scenario dependent logic trees or rule sets. Such approaches, although computationally efficient, require extensive setup and over no potential for portability between simulations or scenarios. The object oriented paradigm offers the possibility of a sophisticated, reusable expert system capable of capturing and reproducing the tactical decision process at the entity level. Coupling such a system to a generalized schema for the representation of tactics offers the opportunity for maximum reuse and portability across simulations and scenarios. Critical capabilities include superior run time efficiency to support Monte Carlo analyses and the ability to readily modify the knowledge base during run setup.

PHASE I: Develop a partial schema for the representation of platform/system level tactics leading to the development of a sample knowledge base. Demonstrate the sample set with a prototype expert system.

PHASE II: Expand the knowledge base schema to support the tactical decision processes associated with a spectrum of Naval platforms, sensors and weapon systems. Incorporate the expert system into an existing campaign or engagement level warfare simulation and demonstrate its function with a sample problem.

PHASE III: The developed expert system will be applied to additional warfare simulations.

COMMERCIAL POTENTIAL: The technology has application to all discrete event simulations used to analyze the performance of complex systems that are affected by human decision processes, including financial and sociological models.

N95-116 TITLE: Global Positioning System (GPS) Integrity Monitoring

OBJECTIVE: Develop improved Receiver Autonomous Integrity Monitoring (RAIM) algorithms for GPS integrity monitoring which can detect integrity failures that result from error drifts over time rather than instantaneous anomalous events. Further, investigate the utility of low cost inertial sensors to aid GPS integrity monitoring. The objective would be to utilize solid state inertial sensors which can be placed on the same electronic card as the GPS receiver.

DESCRIPTION: GPS receivers must be able to detect and reject satellite signals that lead to unacceptable position and velocity errors. Current RAIM algorithms do not have the sensitivity to detect small and slowly varying anomalies. The technical approach shall include detection of small and slowly varying errors in the RAIM algorithms. A second approach to be investigated will use solid state inertial sensors. The utilization of precise multi-satellite GPS delta range measurements should allow accurate estimates of changes in attitude over small intervals. A comparison of the change in attitude over a given time interval as determined by the GPS delta-ranges and the inertial sensor will yield information on the degree that they are tracking each other.

PHASE I: Design and simulate a RAIM algorithm to include detection of small time varying errors. Algorithm performance will be investigated and compared with other RAIM approaches. Conduct a 6 month study to determine the latest available requirements and augmentation plans for non-precision and precision approach integrity monitoring. Develop/adapt models for multi-sensor low cost inertial sensors. Develop algorithms relating inertial sensor outputs and GPS receiver outputs for representative approach dynamic scenarios. Determine observability issues. Perform simulations indicating comparisons on attitude change indications from inertial vs. GPS for various levels of anomalous signal-in-space failures. Parameterize simulations about levels of sensor performance, relative geometry, lever arms, and dynamic profile.

PHASE II: Prototype build and demonstration. Develop and integrate a real-time GPS RAIM algorithm. The real-time algorithm will be integrated with standard aircraft navigation functions and evaluated in a laboratory environment.

PHASE III: Support design and build of ruggedized unit. The RAIM algorithm will be translated to hardware and flight tested.

COMMERCIAL POTENTIAL: The technology has applicability to the commercial aircraft navigation industry. Can be directly used for integrity monitoring for civil aviation.

N95-117 TITLE: Advanced System Trainer

OBJECTIVE: To develop and test an intelligent tutoring system to replace/reduce traditional, labor intensive classroom and team training.

DESCRIPTION: Develop an intelligent tutor focused on conceptual understanding and problem solving skills rather than on procedural behaviors. The intelligent tutor should accurately and efficiently diagnose any trainee's background from responses to curriculum material and should use that diagnosis to adapt and streamline the curriculum presented to that trainee. (i.e. The tutor should automatically determine any individual's training requirements and adapt the training material and skill/comprehension level for optimum individual learning.) The intelligent tutor must present training in a manner to capture the trainee's interest and must run on commonly available hardware.

PHASE I: Examine various innovative methods to automate training. Develop the methodology for replacing team training with individualized computer based training. Outline the structure of an intelligent computer based tutoring system. Describe the knowledge base required by the tutor. To delineate the knowledge base use SURTASS LFA deployment, ADS Operations, or IUSS Operational Readiness Inspections as the target training systems for the tutor.

PHASE II: Develop and test a prototype Advanced training System. The prototype should validate the man-machine interface and the trainer's design approach. The prototype need not implement an actual training capability. Provide cost and schedule estimates for developing a fully capable advanced training system.

PHASE III: Develop and test a fully capable advanced training system.

COMMERCIAL POTENTIAL: The technology developed by this SBIR is equally applicable to other government (e.g. FAA) and commercial training requirements. Changes to adapt the Advanced Training System to these other training requirements will be localized in the knowledge data base.

REFERENCES:
1. Tailored MIL-STD-1379D, Military Training Standards; Multi-Media Embedded Training

N95-118 TITLE: Advanced Signal and Image Processing Algorithms for Parallel Desktop Computing

OBJECTIVE: To develop and demonstrate and advanced signal and image processing detection and alerting application for sensor system data.

DESCRIPTION: Advanced signal and image processing algorithms are sought for 1-D, 2-D, and 3-D image analysis to take advantage of expected advances in high throughput, parallel desktop computing systems. Simultaneous processing using multiple algorithms is desirable. Of particular interest are those transform algorithms that generate signal invariances. This includes invariance under translation, rotation, scale changes, polarization changes (if applicable), etc. Neural networks and expert system approaches are needed for automated feature detection, extraction, and classification from 2-D and 3-D transformed images. Development of these capabilities with low false dismissal rates would allow significant advances in automated image screening. Many areas of interest to both the military and industry require the analysis and evaluation of imagery data. Approaches of highest interest would allow automated screening of large numbers of images, provide for automated alert generation followed by operator review and analysis, allow for multiple scale neural net retinas, provide tools for rapid neural net training, allow for the use of hierarchial networks to aid fusion across multi-spectral representations, and utilize expert system rules for data fusion and false alarm reduction. Examples range from feature detection in X-ray, MR, and ultrasound medical images through non-destructive fault detection in hand-made parts and structures to feature recognition in satellite imagery. The development of advanced signal and image processing algorithms capable of generating transformed and enhanced 2-D or 3-D images in near real-time is of great interest. Any algorithms developed should be capable of being generalized to any type of image or any type of data (e.g., real, complex, etc.). Of particular interest are those transformations that result in either a more simplified feature set or signal invariance. Possible candidate algorithms include: 2-D and 3-D FFTs, wavelets, Gabor functions, and Radon/Hough transforms. Software applications that can be hosted (compiled) on today's high parallel desktop computers will have many possible defense and commercial applications.

PHASE I: A number of these algorithms are to developed using a rapid prototyping approach. This effort shall represent a proof-of-principle demonstration. Associated documentation is to be provided. These algorithms are to be evaluated on at least two government provided data sets of interest in order to quantify their ability to enhance visual detectability of important features. Multiple resolution scales and multiple spectral images should be considered in the evaluation. The ability to run multiple algorithms in parallel for comparison is highly desirable. The performance of the neural net detection and classification algorithms shall be evaluated and the performance documented in the form of ROC curves.

PHASE II: During this effort, at least six additional government provided data sets shall be evaluated to demonstrate the usefulness of these algorithms on a wide range of image types. Efforts shall also be made to ensure that all algorithms can be run at near real-time speeds. A speed of 1/8 real time is required while real time is desirable. Neural net training tools shall also be developed as part of this effort.

PHASE III: Transition this technology to appropriate defense and commercial sensor data collection, sensor data analysis, and sensor communications applications.

COMMERCIAL POTENTIAL: The primary commercial applications of this technology are in automatic rapid or mass screening of medical images for conditions requiring physician follow up and automatic non-human screening for material flaws in mass produced items (i.e. non-destructive testing).

REFERENCES:

1. Digital Image Processing, by Raphael C. Gonzalez and Riochard E. Woods, Addision-Wesley, 1992.
2. Illumination and Color in Computer Generated Imagery by Roy Hall, Springer-Verlag, 1988.
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4. Deans, Stanley R., *The Radon Transform and Some of Its Applications,* rev. ed., 1993, Krieger.
5. Bracewell, R. N., *The Fourier Transform and Its Applications,* 2nd rev. ed., 1986, McGraw.

N95-119 TITLE: Increased Data Throughput on EHF SATCOM

OBJECTIVE: Design, develop and demonstrate a low cost EHF SATCOM baseband VME processor capable of providing an adaptive processing gain of greater than 10 dB. Processor operation must be automatically scalable from data rates of 300 bps up to 1.5M bps to accommodate arbitrary EHF capacity segmentation.

DESCRIPTION: EHF SATCOM is poised to become a critical backbone for Navy Fleet communications. As such, it must be able to provide reliable service under a broad range of conditions, including: benign conditions, atmospheric scintillation, rain attenuation, interference, jamming and service to disadvantaged platforms. What's needed is an adaptive processor which can operate with reduce link margin and still provide additional processing gain when needed by (adaptively) reducing the user information rate to match channel conditions. When conditions are good, the processor should provide a user data rate close to the channel rate, imposing little overhead. The processor should also support both point-to-point and point-to-multi-point communications.

PHASE I: Define the scalable, adaptive processor, specifying the processing it will perform and a hardware architecture capable of supporting this processing. Also, specify how the processor will be integrated with the Navy EHF Communications Controller (NECC).

PHASE II: Develop and demonstrate prototype scalable, adaptive processor.

PHASE III: Integrate the scalable, adaptive processor with Navy EHF SATCOM terminals.

COMMERCIAL POTENTIAL: The technology to be developed would extend the "footprint" covered by commercial satellite links and allow remote mobile terminals to connect reliably to wideband networks, e.g., ATM networks.

N95-120 TITLE:Single Channel Acoustic Broadband Classification

OBJECTIVE: To develop single channel/beam acoustic broadband classification algorithms and techniques.

DESCRIPTION: The objective of this topic is to develop single channel/beam acoustic broadband classification algorithms and techniques. A further goal of this topic is determine the bandwidth of each broadband "swath" of energy associated with a particular target in the channel or beam. Proposals shall address specifically proposed algorithms and fully describe techniques to be employed and tested. Specifically the proposed test procedures will address how the algorithm perform as a function of Signal to Noise Ratio (SNR) i. e. the procedures to develop Receiver Operating Characteristics (ROC) curves shall be fully described. It is expected that the algorithms will perform at SNR's of less than +5dB per frequency-time cell with a probability of detection (Pd) of 0.5 and a probability of false alarm (Pfa) of less than 0.0001. The method or procedure for maximizing the SNR for each frequency-time cell shall be fully described in the proposal.

PHASE I: A demonstration of the proposed algorithms and techniques using GFI Advanced Deployable Systems (ADS) data will be performed. Results of all tests as well as ROC curve data will be reported. Specifications for the algorithms, techniques, and procedures shall be developed and delivered.

PHASE II: The algorithms, techniques, and procedure will be optimized and implemented on a computer workstation such as DTC III or IV. Further testing with GFI ADS data will be performed and reported. A full and complete description of all algorithms, techniques, and procedures will be reported and an A level performance specification developed.

PHASE III: A potential contract award as an ADS subcontractor to the prime contractor in the post DEM VAL ADS program time frame to integrate the algorithms, techniques, and procedures for broadband classification into ADS or SURTASS.

COMMERCIAL POTENTIAL: This development has the commercial potential in non-destructive testing to detect incipient failure in rotating machinery components.

REFERENCES:
1. Theory and Application of Digital Signal Processing, by Lawrence R. Rabiner and Bernard Gold, Prentice-Hall, Inc. 1975. 2. Digital Image Processing, by Raphael C. Gonzalez and Richard E. Woods, Addison-Wesley, 1992.
3. Scientific Visualization, Techniques and Applications, K. W. Brooke et al., Springer-Verlag, 1992.
4. Mission Needs Statement for Undersea Surveillance in Littoral water of 18 March 1993.

N95-121 TITLE: Multi-Band Radar for Ocean Characterization

OBJECTIVE: Develop a multi-band radar capability and associated software to discriminate ocean features.

DESCRIPTION: Ocean characteristics, particularly in the near-coastal/littoral zone are of critical interest to the U.S. Navy for mission planning and tactical decision making. New methods for determining these characteristics need to be developed. Because radar signal response to ocean roughness is a function of radar frequency, a multi-band radar system (e.g., S-, C-, X, and Ka bands) could be used to characterize the ocean surface and discriminate significant surface features. Various ocean features such as convergence and shear fronts, films (thick or thin, natural or artificial), and internal waves can be measured using radar scatterometry techniques. Suitable algorithms to extract and analyze data from a multi-band radar system also need to be developed.

PHASE I: Assess possible alternatives for a multi-band radar system and associated software to derive ocean characteristics based on radar signal response to ocean roughness and propose a candidate system design.

PHASE II: Assemble and test a prototype multi-band scatterometer. Develop analysis algorithms. Test the prototype system. Collect and analyze data and modify algorithms accordingly.

PHASE III: Transition the multi-band radar system to air and space-borne platforms for operational use.

COMMERCIAL POTENTIAL: Oil spill detection, characterization and source location.

NAVAL AVIATION SYSTEMS TEAM

N95-122 TITLE: Frequency Domain GPS Receiver

OBJECTIVE: Develop a frequency domain GPS receiver that will track code and carrier at extremely high accelerations, acquire track very quickly, resist jamming and mitigate multipath.

DESCRIPTION: Conventional GPS receivers are based on delay lock loops, which have inherent limitations in tracking very high accelerations and are also susceptible to multipath and jamming. With the advent of very high speed Digital Signal Processing (DSP) techniques, current technology exists to design GPS receivers with signal processing done entirely in the frequency domain. Although GPS receivers are currently capable of tracking code phase up to 90 g's, they require significant aircraft power and pod rail space. Alternative digital signal processing, such as the fast wavelet transform, may yield a more efficient processing algorithm. Wavelet or other new technology algorithms may allow the decomposition and analysis of GPS signals to filter out unwanted multipath or jamming signals. This type of GPS receiver must output position solutions in real time, be capable of hardware miniaturization, and consume small amounts of power.

PHASE I: Investigate the feasibility and efficiency of DSP techniques for GPS receivers applicable to tracking both code and carrier at very high accelerations, very fast acquisition, multipath reduction, and increased resistance to jamming. The DSP algorithms must be demonstrated through analysis and prototype development. Potential architectures will be investigated to demonstrate a suitable platform with minimal power consumption that can be miniaturized.

PHASE II: Develop, test, and operationally demonstrate the GPS DSP receiver methods formulated under the Phase I SBIR effort.

PHASE III: Verify producibility through low rate initial production.

COMMERCIAL POTENTIAL: New GPS DSP methodology can be used for commercial aircraft and differential base stations that would benefit from filtering out multipath and jamming signals.

N95-123 TITLE: 32-Bit High Throughput Processor/Emulator Chip

OBJECTIVE: Increase the effectiveness of platform upgrades (e.g., F/A-18 E&F) through the application of a 32-bit processor/emulator chip.

DESCRIPTION: The Navy currently uses 16-bit mission computers some with built-in 32-bit risc processors. Future requirements will demand more use of 32-bit processing and even grow to 64-bits. This project is to demonstrate a 32-bitprocessor/emulator chip which can directly execute existing AN/AYK-14 code and/or MIL-STD-1750 code.

PHASE I: Provide a feasibility study which analyzes technology, industry projections and emerging products leading to the design and demonstration of a modular 32-bit processor which can directly and efficiently execute AN/AYK-14 and/or MIL-STD-1750 source code. Particular attention should be given to the at sea operational environment for naval aircraft.

PHASE II: Develop, test and operationally demonstrate the modular processor/emulator identified during the Phase I SBIR effort including the ability for self test, if feasible.

PHASE III: Produce the modular processor/emulator demonstrated in the Phase II effort. Includes transition to other Navy programs such as the AN/AYK-14, F/A-18 E&F P^{3}I, others which currently use AN/AYK-14 or MIL-STD-1750.

COMMERCIAL POTENTIAL: Direct application to commercial versions of the AN/AYK-14 and MIL-STD-1750 computer families.

REFERENCES:

1. MIL-E-5400 Class 2
2. MIL-E-16400 Class 2
3. AN/AYK-14 Source Code
4. MIL-STD-1750 Source Code

N95-124 TITLE:Innovative Solid-state Blue or Blue-Green Laser

OBJECTIVE: Develop innovative, solid-state laser(s) having wavelengths in the range from 470-520 nm to better match the optimum transmissivity of seawater.

DESCRIPTION: The Navy is currently developing non-acoustic (electro-optic) sensors for use in various missions from air platforms. Solid-state lasers are essential to meet the packaging required for operation from Navy aircraft, due to size, weight, and power efficiency considerations. To-date, the only solid-state lasers meeting the packaging constraints operate at wavelengths which do not match the optimum for maximum transmission in seawater. Limited testing with gas and dye lasers have shown there to be a substantial benefit from operation at optimum wavelengths. Recent research in industry has shown the potential of developing new laser technology which will produce output in the desired wavelength range. The development of such lasers will substantially increase the capability of such non-acoustic sensors to meet Navy operational needs.

PHASE I: Demonstrate, using laboratory breadboard equipment, basic materials parameters necessary for operations of the desired laser. This demonstration will include laser spectroscopy testing to determine optical gain in the material, and a determination of the net lasing efficiency to be anticipated in Phase II. Perform a feasibility study to determine the optimum pump, cavity, and lasing material configuration for Phase II.

PHASE II: This phase is further subdivided in two parts:

PHASE IIA: Using the feasibility study performed in Phase I, construct an operating breadboard laser. Using this laser, evaluate performance, including particularly net power efficiency, output stability, and performance envelope as a function of pulse repetition rate. Perform scaling study to determine the optimum laser configuration to proceed to Phase IIB.

PHASE IIB: Building on the previous work, perform engineering necessary to demonstrate a brassboard laser having the requisite performance characteristics to meet current Navy requirements. For the purpose of this topic, this is to be interpreted as a minimum of 10 Watts average power at a pulse repetition rate of 40Hz or greater.

PHASE III: Perform the engineering necessary to productize the laser in a configuration providing optimum power efficiency and minimum packaging volume. This will be transitioned into the NAASW program.

COMMERCIAL POTENTIAL: There is a substantial existing market for lasers having output in this wavelength range. This laser, because of its smaller size and greater power efficiency, is expected to displace existing laser technology in some of these applications, and to create other applications which present lasers cannot fill due to weight, size, and power constraints. In particular, lasers in this wavelength range are frequently used in opthamology.

REFERENCES:
1. MIL-STD-1425

N95-125 TITLE: Radar-Sonar Data Fusion for Clutter Suppression Improvements in Shallow Water Submarine Detection and Classification Performance

OBJECTIVE: Provide a demonstration of quiet submarine detection and classification performance improvement in shallow water obtainable by data fusion of coincident radar and sonar scattering data to reduce the false alarm rate in both sensors.

DESCRIPTION: Detection and Classification of Quiet Submarine Targets in Shallow Littoral ocean areas to support combined operations with integrated intelligence information communications can be improved by exploiting the complementary nature of Low Frequency Active (LFA) acoustic sensor data and collocated radar maps of surface shipping. Active acoustic sonar returns are often dominated in shallow water environments with multi-path reverberations reflected from bottom surfaces of variable reflectivity and sea water thermal layers with time variable scattering properties - making operator detection of target returns and distinguishing them from clutter reflections from surface ships quite difficult. Superposition of radar knowledge of surface ship positions on an acoustic tactical plot should allow noise and clutter suppression in the acoustic signal data (by screening out sonar scattering signals emanating from radar identifiable large radar crossection (rcs) surface ship locations) with the potential for significantly reducing the sonar false alarm rate. Conversely integration of acoustic source classification and positional information with the radar tactical picture may facilitate the process of distinguishing short time, small rcs periscope detection radar returns from the brown water clutter produced by small boats and floating trash. Integrated passive and active acoustic classification/range/bearing and Doppler information should be useful here when effectively coupled with radar rcs/range/ bearing and Doppler information as evidence of transient radar contact identity.

Accurate data fusion of disparate data from multiple sources of differing resolution, timeliness and confidence into a single self-consistent tactical data frame will best be accomplished through registration of sensor coordinate systems with a common GPS space time data frame. Innovative techniques are needed for data fusion processing which can handle low and variable precision asynchronous acoustic and electromagnetic multi-sensor data derived from distributed heterogeneous processors. This data fusion process must filter noise and clutter, extracting and combining salient information from active and passive systems to develop a single accurate self-consistent tactical picture of target tracks. Algorithms should be scalable to real time operation on an existing computer architecture (eg. a parallel array processor with as many as 32 nodes, each with no more than 64 megabytes of memory).

PHASE I: Design and develop a data fusion algorithmic software system which will be able to demonstrate candidate radar/sonar data fusion algorithm performance under parametrically varying signal to noise & clutter conditions; as a part of this algorithm design effort devise integrated data fusion algorithms appropriate to handle typical shallow water propagation conditions, variable environmental/weather conditions and cluttered operational conditions using GFI Navy standard propagation/noise and clutter models to the greatest extent possible. Determine the feasibility of significantly improving detection & classification performance with data fusion clutter reduction techniques.

PHASE II: Implement a simulation of the data fusion algorithmic system designed in phase I using GFI support software and hardware to the greatest extent possible (eg. the MASS program data fusion simulation software driver and GFE Sun 4 work stations) and test algorithmic processing performance under typical operational conditions using digitized recordings of integrated multi-sensor sea data when available as GFI.

PHASE III: Transition to Navy ASW platform and implement optimally performing algorithms in militarized computer environment (eg. USQ-78A)

COMMERCIAL POTENTIAL: The capability of taking two sensors and integrating the results for improved performance is useful in the medical community. By using both active and passive (for example ultrasound and audio), there would be increased accuracy's in diagnoses.

REFERENCES:
1. Oceanographic and Atmospheric Master Library Summary, Naval Oceanographic Office Report No. OAML-SUM-21B January 1992.
2. Copernicus Project Phase 1 Report, OP-94, Aug 1991.

N95-126 TITLE: Rugged CD-ROM Optical Disk Drive

OBJECTIVE: Develop an affordable CD-ROM optical disk drive system architecture for operation in harsh environments.

DESCRIPTION: CD-ROM has becoming a very affordable and popular means of distributing large volumes of electronic information. There have been a number of proposed military applications which require the use of a ruggedized CD-ROM drive. The commercial marketplace has, until now, been unwilling to address this need. Data that does not change frequently such as digital maps and maintenance data, would be stored and accessed directly from a rugged CD-ROM. The drive shall be utilized for shipboard, airborne, and fielded applications. The CD-ROM drive shall have the ability to withstand harsh land based environments such as desert and arctic conditions and be designed for use in battlefield situations on board fighter aircraft, RPV's, small ships, tanks, and land vehicles. It shall have the ability to read standard IEC 908, ISO-10149, ISO-9660 CD-ROM media (120, 90mm) as well as CD-Recordable technology.

The completed drive would be capable of meeting or exceeding the following baseline specifications:
* Capacity 650 MB* Operating altitude to 80,000 ft
* Multi-Session,Multi-Media Compatible * Humidity - 95%
* 2 X Transfer Rate* Operational vibration - 6 Grms from 20 to 20,000 Hz
* -20_C to +71_C Operating Range* Shock 30 g's for 11 msec Survival

PHASE I: Phase I would consist of an investigation of the technology-status of suitable digitally adaptive electronics, a plan to modify and/or design a CD-ROM deckplate for use in military optical disk systems, and developing media protection plan methods for harsh environments.

PHASE II: Phase II would consist of fabrication of a mechanical transport with MIL-E-5400 equivalent anti-shock housing and vibration isolation system, provide mechanical integration and mechanical integrity tests, and provide a complete electronic system design consisting of controller and READ/WRITE electronics, optical head and servo system. Thorough environmental testing would be accomplished on the completed unit with delivery of two prototype flight systems, test reports, instruction manuals, and other documentation.

PHASE III: Produce the ruggedized CD-ROM drive demonstrated in the Phase II effort. Transition efforts will include incorporating the drive into existing aircraft platforms.

COMMERCIAL POTENTIAL: Current audio CD players in cars do skip occasionally resulting in a loss of bits of data. This is rarely noticed in music. Forecasts in the Intelligent Vehicle Highway technology indicate that a CD-ROM optical disk drive system in the future will not be able to afford to drop even a bit of data without affecting the performance. Applications would include digital mapping, travel advisories or emergency information and numbers. Commercial airlines are also exploring the use of CD-ROMs for on-line technical manuals and information which, again, will be more sensitive to dropped bits.

REFERENCES:
1. ISO-9660
2. ISO-10149
3. MIL-SPEC 2036 (Modified and Ruggedized Commercial Off-the-Shelf)

N95-127 TITLE: Ultra High Speed Processor

OBJECTIVE: Increase the throughput of image and/or other sensor processing through the application of cost effective ultra high speed processors which are application specific.

DESCRIPTION: Future naval applications may require the ability to process imagery and other data at extremely high rates in order to form real time perspective or three dimensional scenes. Electronics technology and associated design aids are progressing to the point where it is feasible to develop and demonstrate application specific processors which are capable of throughputs meeting or surpassing supercomputers for specific operations in a highly affordable fashion. Such application specific processor technology may be modular and packaged within racks with other avionics hardware.

PHASE I: Provide a feasibility study which analyzes technology and specific needs of real time perspective scene generation and defines an approach to processing such imagery. Particular attention should be given to working with various military sensors including both on-board and off-board sources of imagery. Wherever feasible solutions should include either commercial or Navy owned software (i.e. PowerScene), preferably written using existing or projected commercial standard graphics language, and appropriate visualization media. The approach to demonstrating a specific demonstration in a Phase II SBIR effort shall be defined.

PHASE II: Develop, test and operationally demonstrate the ultra high speed image processor defined during the Phase I SBIR effort. Study and define self test and maintenance concepts.

PHASE III: Produce the modular ultra high speed processor system demonstrated in the Phase II effort. This will include transition to other Navy programs in airborne situational awareness.

COMMERCIAL POTENTIAL: Application specific ultra high speed processor technology should have payoff in numerous commercial applications such as remote real time surgery, robotics, news media, and others.

REFERENCES:

1. IEEE Graphics Language Standards, MIL-E-5400 Class II

N95-128 TITLE: Adaptive Beamforming for Mutistatic Active Sonar

OBJECTIVE: Develop a set of mathematical algorithms to efficiently implement a beamformer for multistatic sonar systems that can automatically adapt to a highly variant noise field.

DESCRIPTION: A set of mathematical algorithms is required to adaptively form beams from sonar arrays used as the receivers in multistatic active fields. Optimum suppression of ship radiated noise and scattering from topographical features is required to obtain maximum effective array gain. Sound sources will be both impulsive broadband as well as both narrow and broadband coherent. Maximum algorithm efficiency in terms of processing requirements is desired to minimize processing resources to allow for potential implementation in expendable sensors.

PHASE I: Study and develop adaptive beamforming algorithms for active multistatic applications that automatically suppress directional interference sources with little or no degradation of signals. Examine real data on successive range bins and mathematically determine algorithm effectiveness in improving echo to noise ratios while suppressing false alarms.

PHASE II: Design and implement on a commercial system an active multistatic adaptive beamformer.

PHASE III: The Navy may implement an efficient adaptive beamformer in all air ASW aircraft as well as in expendable sensors.

COMMERCIAL POTENTIAL: Efficient algorithms developed under this SBIR may offer breakthroughs in diagnostic acoustics in the medical field, seismic surveys, and other acoustic diagnostics throughout industry.

N95-129 TITLE: Expendable Small Object Avoidance (SOA) Sonar Detector

OBJECTIVE: Determine if technology can be adapted or developed to make a low cost expendable sonar practical for the detection of mini-submarines, bottomed submarines and mines.

DESCRIPTION: Systems are in development using electro-optic (E-O) techniques for the detection of small objects in shallow littoral waters. A complementary expendable acoustic system would be beneficial to these systems for reduction of false alarms and to overcome the deleterious effects of turbidity. The problem to be solved is the tradeoff of materials and technologies necessary to achieve an air dropable acoustic system that can be built at low unit cost and can be packaged in a form factor no larger than a right circular cylinder 4.75" in diameter and 36" in length.

PHASE I: (1.) Conduct a tradeoff study to determine the technical parameters necessary in an expendable sensor to complement existing and planned helicopter employed E-O systems for the detection of small underwater objects. Measures of effectiveness shall include the helicopter search rate and false alarm rate, with and without the proposed expendable active acoustic sensor.

(2.) Conduct a technology search study to determine the critical technologies that need to be developed to meet the technical parameters determined in (1.) above. Include in this study the required sensor and field processing to achieve optimum tactical performance.

(3.) Perform a unit cost study as a function of yearly purchase quantities and performance parameters.

PHASE II: Design and manufacture a prototype low cost expendable sonar in an "A" size (Diam: 4.75", Length: 36") package that will effectively complement existing helicopter E-O systems.

PHASE III: Navy procurement of a low cost expendable that will improve the fleet's ability to avoid mini submarines, bottomed submarines and mine fields. Transition will be accomplished with a sonobuoy development program with either Advanced Development or Engineering Development funds, depending on remaining technical risks after the completion of PHASE II.

COMMERCIAL POTENTIAL: High-energy acoustic ceramics and batteries required to meet this requirement have numerous applications in high frequency acoustic applications in the medical field and throughout industry in materials and structural test. Tracking marine animals and survey of underwater objects are other potential commercial applications.

N95-130 TITLE: Fault-Tolerant Navy Tactical Data Processing

OBJECTIVE: Use scalable, fault-tolerant computing systems/modules in handling Navy tactical data to ensure fail-safe operation without compromising performance/mission safety. Organic (embedded) computers play a significant role in controlling critical military and civilian functions. The increasing complexity in modern military and industrial equipment increases the probability of malfunctions or mission failures. Failure in any of these computers can be catastrophic, particularly, when the environment becomes hostile due to an act of nature or war. Use of multiple fault tolerant computing systems is a way of ensuring/minimizing fail-safe operation without compromising mission safety. These proposed systems will allow redundancy to be designed throughout the next generation of platforms. The scalability of these systems permit configuration selection based on the number of likely faults within the Mean-Time-To-Repair to ensure continuous fail safe operation.

DESCRIPTION: Develop an innovative, "dual use", multiple fault tolerant, VMEbus and Futurebus+-based computer systems capable of executing real-time Ada/Ada 9X code. VMEbus and Futurebus+have been chosen because of their world-wide usage in military and commercial applications.. The proposal should use a high performance and ultra-reliable RISC computing engine (ex., Intel i960 RISC processor because of its usage in newer systems (F-22, among others)), designed with redundant parts and special fault handling capability, that continues working in-spite of several component failures. These computers (Intel i960 RISC VMEbus and Futurebus+) will be scalable, i.e. users can select application specific configurations for the degree of fault tolerance required, making it efficient and inexpensive. It also permits fault tolerance to be extended outside the computing platform, providing the opportunity, to make the entire application fault tolerant. The approach will be to add fault tolerance to existing technology rather than design it from scratch.

PHASE I: Define the prototype tactical data system. Define the technical performance/reliability requirements the fault tolerant system modules must meet. Define the system tactical interfaces (1397, 188-C, 1553B, etc.) data input/output requirements.

PHASE II: Develop, test and prototype tactical data interface modules, perform design verification and testing for manufacturability/producibility based on definitions/requirements of Phase I. Begin development of commercial market

PHASE III: Develop, test and integrate modules developed under Phase II into tactical data system. Conduct system integration testing. Transition to commercial production. Deliver to Fleet.

COMMERCIAL POTENTIAL: Civilian equipment, driven by intelligent computing engines, requiring a high degree of on-line performance, can benefit from these systems such as: Emergency life support, Power Plant and electrical distribution systems, On-line transaction processing, Traffic control equipment (air traffic control, MagLev Trains, subway systems), Future national computer networks and databases

REFERENCES:

1. MIL-STD-1397
2. MIL-STD-1553(B)
3. MIL-STD-188C
4. MIL-STD-SDD

N95-131 TITLE: Digital Voice Signal Distribution for Crew Communication

OBJECTIVE: Improve aircraft communications by implementing an interphone communications capability having digital signal interfaces with microphones, earphones, and radios.

DESCRIPTION: Current interphone communication systems either distribute analog voice communications, or provide digital interphone signal routing with digital to analog (or analog to digital) conversion of voice signals prior to interface with analog microphones or earphones. The effort identified here, is to describe a hardware and software approach to a completely digital signal routing and control capability enabling digital voice information to come directly from microphones or to be provided directly to earphones, and which uses direct digital interface with radios.

PHASE I: Provide a feasibility study which develops a method to provide total digital voice signal distribution of interphone communications through to the crew member's headset. This process will concentrate on defining the signal conversion at the microphone and earphone, and the interphone signal distribution and control implementation. The signal distribution will utilize digitized audio compatible with the wideband audio input and output of receiver/transmitters such as the AN/ARC-182 and AN/ARC-210. The bus structure for signal interconnectivity is to use fiber optics. The interphone communication units shall be modular and of minimum weight, size, and cost with applicability to such aircraft as the E-2C, P-3C, CH-53, and CH-46E. The feasibility of an embedded approach using software to control the interface with other multifunction controls and displays will also be evaluated. Coordination of this work will be established with appropriate aircraft and crew systems PMAs.

PHASE II: Develop, fabricate, test, and operationally demonstrate the digital voice signal distribution functions formulated for interphone communications during the Phase I SBIR effort.

PHASE III: Produce components of the digital voice signal distribution system, thereby providing system availability and enabling transition onto multi-crew station aircraft.

COMMERCIAL POTENTIAL: This process of total digital intercommunications is an expansion of current trends for digital signal processing of communications to improve signal reception and transmission. Additionally, this process offers potential for embedding interphone communication system (ICS) control functions for software implementation. It will have its greatest potential on aircraft with multiple crew stations.

REFERENCES:

1. MIL-R-29583 (AS) Radio Set, AN/ARC-210(V)
2. MIL-R-85664 (AS) Radio Set, AN/ARC-182(V)

N95-132 TITLE: Corrosion Preventive Compounds or Preservative with Lower Volatile Organic Compound Content

OBJECTIVE: Develop corrosion preventive compounds (CPC) or preservatives with water displacing characteristics using the state-of-the-art technology to meet current environmental laws/regulations and the performance requirements of MIL-C-81309, MIL-C-85054, MIL-C-6529, MIL-C-16173, MIL-C-11796, MIL-L-63460, or for a specialized application.

DESCRIPTION: Some current state and local environmental laws/regulations restrict the use of CPC or preservatives and the National Emissions Standard for Hazardous Air Pollutants will have limitations for CPC or preservatives in 1997. CPC or preservative is used in various applications for aircraft structure, avionics/equipment and engines. The NAVAIR 01-1A-509 Aircraft Weapons Systems Cleaning and Corrosion Prevention/Control manual, the NAVAIR 16-1-540 Avionics Cleaning and Corrosion Prevention/Control manual, and the NAVAIR 17-1-125 Support Equipment and Corrosion Control manual contain CPC or preservative applications.

PHASE I: Develop new CPC formulation(s) with water displacing characteristics that meet current environmental laws/regulations and the performance requirements for its target application(s). Identify new formulations and potential applications. Conduct preliminary laboratory testing to demonstrate the feasibility of the CPC or preservative formulation for its target applications.

PHASE II: Further develop new CPC formulation(s) based on phase I results. Conduct preliminary laboratory testing and field testing. Also, conduct comparison testing with the CPC being substituted. The above comparison testing shall demonstrate that the new CPCs meet all the performance requirements and the environmental laws/regulations for the target application(s). If necessary, propose amendments to existing military specifications or propose new military specifications for these CPCs to cover their technology.

PHASE III: Produce the CPC formulation(s) demonstrated in the phase II effort for both the military and commercial market.

COMMERCIAL POTENTIAL: New CPCs can be used on commercial aircraft as well as non aerospace applications for both government and private sector.

REFERENCES:
1. MIL-C-81309
2. MIL-C-85054
3. MIL-C-6529
4. MIL-C-16173
5. NAVAIR 01-1A-509

N95-133 TITLE: Integrated Product Data Environment

OBJECTIVE: Reduce weapon system support cycle time and associated costs through the use of an Integrated Product Data Environment (IPDE) in manufacturing and rework facilities.

DESCRIPTION: Currently the aviation engineering and manufacturing activities utilize a combination of paper and digital product data for the design, manufacture or rework of a system, equipment, or component. This data is stored within functional areas and is not readily accessible between functional areas. The vision of an IPDE is for all or parts of a single activity and its suppliers to be able to work from a common digital data base, in real time, on the design, development, manufacturing, distribution, and servicing of a weapon system, equipment, or component. The direct benefits would come through substantial reductions in cycle time and costs, along with significant enhancements in quality and performance.

PHASE I: Provide a concept study that integrates: product data to provide a consistent view of all product information across the enterprise; an information highway to provide access to the integrated product data; the interconnection of work processes throughout the enterprise; and reengineered business processes that take maximum advantage of integrated product data and product data tools for workers to efficiently and effectively support a weapon system.

PHASE II: Develop and test a prototype IPDE, formulated under the Phase I SBIR effort, at a NAVAIR rework facility to demonstrate and document its feasibility and benefits. Based on the prototype provide a technical architecture that will allow for IPDE implementation.

PHASE III: Implement the IPDE, documented in the Phase II SBIR effort, throughout the NAVAIR rework/manufacturing facilities.

COMMERCIAL POTENTIAL: The developed product would give industry a structure that will allow for radical improvement in the management of product data. The direct benefits to industry would be a substantial reduction in product development cycle time and costs, along with significant enhancements in product quality and performance.

REFERENCES:
1. MIL-STD-1840
2. MIL-D-28000 & 28003, STEP

N95-134 TITLE: Recycling of Cured Composite

OBJECTIVE: To develop a process to recycle cured composite materials and to develop uses for the recycled product.

DESCRIPTION: The navy currently uses composite materials in aircraft structure due to the high strength, environmental resistance and light weight. Unlike metals composites can not be easily reprocessed into new parts due to the chemical changes that occur during processing. Composite material contain high value fibers that can provide improved properties to a number of marketable products in DoD and the commercial sector. This effort will develop methods to utilize the superior properties of the high strength fibers found in cured composite material in a marketable product. Recycling will reduce the amount of composite in landfills, provide a means to dispose of retired composite structures and provide a payback to the processor to offset the cost of recycling.

PHASE I: Evaluate state of the art processes to reduce composite structures into useful forms that may be used as reinforcement, fillers and additives to commercial products. These processes should include mechanical, chemical and thermal methods to recycle cured structures. Potential uses of the recycled materials should also be identified along with market size, product form requirements and cost.

PHASE II: In this phase the most promising reduction method will be scaled up and used to produce sample quantities of material which will be used to fabricate a marketable product. The cost of recycling the composite, fabrication of the marketable product and the performance of the product will be evaluated.

PHASE III: In this phase a full scale recycling facility will be set up to reduce cured composite material to a useful product form. This facility may be stand alone or in conjunction with the facilities of the secondary product fabricator.

COMMERCIAL POTENTIAL: The use of composite materials in the construction and transportation industries will provide both a source of composite materials and a potential for secondary uses.

N95-135 TITLE: Adhesive Bond Integrity of Composites

OBJECTIVE: To clearly define nondestructive inspection (NDI) methods using state-of-the-art technology to determine adhesive bond strength integrity quantitatively vice qualitatively.

DESCRIPTION: With the continuing rapid improvements in advanced composite materials technology, adhesive bonding integrity is always a matter of concern. In particular, this concern applies to commercial aerospace applications as well as high performance military aircraft. Adhesive bond integrity affects commercial and military aircraft application since employment of advanced composite materials are being expanded as a means to reduce weight and corrosion.

PHASE I: Perform search of commercially available NDI equipment and potential modifications or develop new equipment to meet the objective. Conduct preliminary laboratory testing to demonstrate the feasibility of the potential NDI method. Also, as a means of screening for potential NDI techniques for determination of adhesive bond integrity.

PHASE II: Development of NDI methods and testing of prototype inspection equipment as determined from Phase I feasibility studies. The design development and testing of prototype NDI equipment shall be accomplished. Additionally, the prototype inspection unit shall be a deliverable.

PHASE III: Commercialize NDI equipment and inspection methodology.

COMMERCIAL POTENTIAL: Extensive commercial and military industrial applications.

N95-136 TITLE:Ultrahigh Fidelity Inspection of Advance Composite Materials

OBJECTIVE: To clearly define nondestructive inspection (ND) methods using state-of-the-art technology to determine the orientation of laps, gaps, and ply layer of occurrence in advanced composite materials.

DESCRIPTION: New designs and manufacturing processes are rapidly improving the strength and fatigue characteristics of many advanced composite materials. The performance of many of these new composite materials is highly sensitive to ply orientation, lap and gap thicknesses, fiber waviness, etc. There is a critical need in both the commercial and military aircraft industries for NDI techniques which are capable of quantifying variations in ply orientation, etc. Ultrahigh fidelity inspection of advanced composite materials requires additional research in defining tape imperfections, proper fiber placement, orientation of laps and gaps, and through thickness ply location. The increased sophistication of advance composite materials being considered for use on commercial and military aircraft as a means to reduce weight and maintenance costs requires improved inspection methods to assure material integrity.

PHASE I: Perform literature search of ND methodology and of commercially available ND equipment as a means of screening for potential ND techniques and methods for determination of advanced composite materials integrity. Conduct preliminary laboratory testing to demonstrate the feasibility of the potential ND technique(s) and method(s).

PHASE II: Development of ND method and/or prototype inspection equipment as determined from Phase I feasibility studies. The design development and testing of prototype ND equipment shall be accomplished. Additionally, the prototype inspection unit shall be a deliverable.

PHASE III: Commercialize ND equipment and military industrial applications.

COMMERCIAL POTENTIAL: Current potential for use of this technique/equipment exists in the commercial and private aerospace industry and a future potential for the automotive industry as more advanced composite materials are utilized.

N95-137 TITLE:Wearable Electronics for Man Machine Interface

OBJECTIVE: Increase the functionality and productivity of the human operator while decreasing the life cycle cost of associated electronics.

DESCRIPTION: The Navy currently uses non-portable computers and equipment for most applications which involve interfacing with an operator. Digital electronics technology has been progressing at a rate which doubles about every two years and is expected to do so for the remainder of the decade according to the semiconductor industry association. Emphasis in commercial digital and analog electronics has changed direction from relatively stationary electronics to man portable electronics and is expected to migrate to wearable electronics in the near future. Wearable electronics potentially could increase the efficiency and productivity of personnel in training, conducting maintenance, rehearsing missions, operating equipment, etc. Future hardware may enhance performance of military systems operations without building expensive and rapidly changing electronics into the platform itself.

PHASE I: Provide a feasibility study which analyzes technology, industry projections and compares such to the needs of the Navy to perform training, maintenance, rehearsal, and military operations in a carrier based aviation environment. Particular attention should be given to the at sea operational environment and, if necessary, applications should distinguish between land and sea based operations. Near to far term applications of wearable systems shall be identified and reported along with an approach to demonstrating high payoff applications in a Phase II program including power source, electronics and human interface hardware (e.g., displays, earphones, voice recognition, etc.)

PHASE II: Develop, test and operationally demonstrate various wearable subsystems identified during the Phase I SBIR effort. Study and project any special maintenance, safety, or operational requirements for such wearable systems.

PHASE III: Produce the wearable electronics subsystems and systems demonstrated in the Phase II effort. This will include transition to other Navy programs such as training, mission planning, maintenance, operational systems, etc.

COMMERCIAL POTENTIAL: Wearable electronics could find numerous commercial applications in training equipment operators, performing maintenance, rehearsing scripts, and enhancing operations.

REFERENCES:
1. MIL-E-5400 Class 2
2. MIL-E-16400 Class 2

N95-138 TITLE: Realistic Correlated Infrared Sensor Scene Generation

OBJECTIVE: To improve the correlation of simulated Infrared Sensor (IR) scenes with out-the-window scenes synthesized from digital terrain elevation data and satellite imagery and/or aerial photography, thereby enhancing mission planning, mission preview, mission rehearsal, and training activities.

DESCRIPTION: Visual simulation systems capable of generating synthesized dynamic perspective views of the terrain from actual satellite imagery and/or aerial photography with digital terrain elevation data have the potential to enhance greatly the effectiveness of mission planning, mission preview, mission rehearsal, and training activities. Currently lacking, however, are correlated views of the terrain for sensors, such as Infrared (IR), with the same high degree of realism and fidelity as the visible spectrum scenes. This effort will develop innovative techniques for deriving high- fidelity IR scenes from the same data sources as are used to generate the visible spectrum scenes, specifically digital terrain elevation data and visible spectrum (400 to 700 nanometers) imagery.

PHASE I: Provide a feasibility study which develops one or more methods for specific sensor systems capable of deriving realistic, high-fidelity IR scenes from digital terrain elevation data and actual terrain imagery in the visible spectrum. The methods shall be highly automated, requiring virtually no human interaction, and shall be capable of implementation on relatively low-cost engineering workstations. Preprocessing of imagery and elevation data to derive intermediate data, such as terrain material classifications, shall be permitted, but techniques which require no such preprocessing shall be preferred.

PHASE II: Develop, test, and operationally demonstrate the IR scene synthesis techniques formulated under the Phase I SBIR effort.

PHASE III: Incorporate the methods demonstrated in the Phase II effort with existing and emerging Navy mission planning, mission preview, mission rehearsal, and training systems.

COMMERCIAL POTENTIAL: Improvements in the correlation of simulated IR with out-the-window scenes synthesized from digital terrain elevation data and satellite imagery and/or aerial photography has numerous commercial applications, among them an increased ability to portray remotely sensed scenes as well as advancing the state of the art in our ability to map and chart mineral deposits.

N95-139 TITLE: Realistic Correlated SAR Scene Generation

OBJECTIVE: To improve the correlation of simulated Synthetic Aperture Radar (SAR) scenes with out-the-window scenes synthesized from digital terrain elevation data and satellite imagery and/or aerial photography, thereby enhancing mission planning, mission preview, mission rehearsal, and training activities.

DESCRIPTION: Visual simulation systems capable of generating synthesized dynamic perspective views of the terrain from actual satellite imagery and/or aerial photography with digital terrain elevation data currently exist and have the potential to enhance greatly the effectiveness of mission planning, mission preview, mission rehearsal, and training activities. Currently lacking, however, are correlated views of the terrain for sensors, such as Synthetic Aperture Radar (SAR), with the same high degree of realism and fidelity as t visible spectrum scenes. This effort will develop innovative techniques for deriving high- fidelity SAR scenes from the same data sources as are used to generate the visible spectrum scenes, specifically digital terrain elevation data and visible spectrum (400 to 700 nanometers) imagery.

PHASE I: Provide a feasibility study which develops one or more methods for specific sensor systems capable of deriving realistic, high-fidelity SAR scenes from digital terrain elevation data and actual terrain imagery in the visible spectrum. The methods shall be highly automated, requiring virtually no human interaction, and shall be capable of implementation on relatively low-cost engineering workstations. Preprocessing of imagery and elevation data to derive intermediate data, such as terrain material classifications, shall be permitted, but techniques which require no such preprocessing shall be preferred.

PHASE II: Develop, test, and operationally demonstrate the SAR scene synthesis techniques formulated under the Phase I SBIR effort.

PHASE III: Incorporate the methods demonstrated in the Phase II effort with extant and emerging Navy mission planning, mission preview, mission rehearsal, and training systems.

COMMERCIAL POTENTIAL: Improvements in the correlation of simulated SAR with out-the-window scenes synthesized from digital terrain elevation data and satellite imagery and/or aerial photography has numerous commercial applications, among them an increased ability to portray remotely sensed scenes as well as advancing the state of the art in our ability to map and chart mineral deposits.

N95-140 TITLE: Unmanned Aerial Vehicles (UAV) Imagery Processing for Geophysical Information System (GIS) Applications

OBJECTIVE: Investigate sensor suite and imagery processing workstation for Unmanned Aerial Vehicles (UAV) to be used in collecting geographic/geophysical data and build a low cost Geophysical Information System (GIS) for mission planning and targeting selection.

DESCRIPTION: Geophysical information systems(GISs) traditionally have been used by the Air Force in weapons avionics and mission planning in which expensive satellite data and long lead-time planning/data reduction effort are required to built a GIS for limited applications. A UAV with GPS aided autonomous navigation system can serve as a low cost sensor platform for collecting precise geographic images/conducting geophysical survey in near realtime; the envisioned UAV sensor may be 3-D imaging with stereoscopic staring sensor, laser range finder for precise distance measurement, or multispectral sensor for locating natural/artificial artifacts, etc.; the latest commercial computer workstation and off-the-shelf image processing/GIS software may be used to build a multidimensional and features laden map/database by the lower echelon commander for their operational area for near realtime mission planning and force maneuver and target selection.

PHASE I: Investigate the sensor suite enhancements for the UAV and identify an imagery processing workstation/software for UAV GIS applications. Perform requirements analysis, architecture definition, and conduct technology trades.

PHASE II: Develop prototype hardware/software, and demonstrate a low cost UAV Imagery Processing/GIS system.

PHASE III: Productize the UAV GIS sensor(s) and imagery processing/GIS workstation and conduct field test.

COMMERCIAL POTENTIAL: The UAV GIS system has potential applications for law enforcement, i.e., build a GIS database for correlation/analysis of crime patterns and trends, command and control/tactical decision aid database during emergency response; The UAV GIS system can also be used during Federal Emergency Management Agency (FEMA) emergency response coordination and disaster relief effort. Other commercial applications include building accurate geophysical survey/GISs of existing utility grids or gas pipelines or highways/bridges for periodic maintenance and emergency repairs, urban development area surveying/zone planning, agricultural resources/land utilization management, etc.

N95-141 TITLE: Effective Retrieval of Human Technical Knowledge

OBJECTIVE: Develop an effective method of obtaining information from individual expert technical personnel for use in subsequent training computer-based training courses.

DESCRIPTION: Computer Based Training (CBT) systems have been shown to promote high learning training effectiveness and cost effectiveness. The most essential ingredient in these systems is the specific technical knowledge which they are designed to transmit. However, it is very difficult to retrieve this data stored in the technicians brains and record it on a more permanent and adaptable storage medium. A concept for a Naval "Electronic Capture and Handling, Integrated Engineering Facts" system (*e-CHIEF*) shall be formulated, designed and implemented to provide an effective method of obtaining the knowledge from the individual and using it in multiple, broad-based CBT applications, using a phased approach.

PHASE I: Establish basic *e-CHIEF* functional requirements, and define the psychological, training and technological methods to be used to satisfy those requirements. The primary product will be a system design specification for processes and tools to effectively transmit technical knowledge from practitioners to a computer data base.

PHASE II: Develop *e-CHIEF* processes and the human and computer-based tools to support it. These computer based tools (ie, "the system") will feature maximum open architecture, broad applicability, and easy adaptation for use in each specific knowledge specialty. The system will facilitate separating the raw knowledge into discrete areas of technology to enable the information to be used functionally, across multiple applicable learning programs. PHASE II will conclude with a demonstration of a database produced using the system in an actual "knowledge transmission session." The products of Phase II will consist of written documentation of the processes to be used in conducting information-gathering sessions, and the computer-based tools (software) designed to assist those processes.

PHASE III: Refine *e-CHIEF* system and transition it into the mainstream. Here, the documentation of the processes and the design of the software tools will be finalized. Products include the processes and software tools as well as the initial *e-CHIEF* data base of recorded technical information.

COMMERCIAL POTENTIAL: Full application to business and academia training programs.

N95-142 TITLE: Low Cost Image Generator for Mission Rehearsal

OBJECTIVE: Investigate affordable high performance computational elements to develop real-time photo-texture based image generators (IG) for mission rehearsal.

DESCRIPTION: With the increased emphasis on synthetic environments Military and commercial trainer systems of the future will require affordable texture based Image Generator's. Requirements exist in areas such as mission rehearsal, mission planning and mission preview to utilize Photo-textured scene's as the primary planning tool. There are several companies developing boards for systems that are ADVERTISED to provide texture-based, image generator's at 30HZ. These boards (1 or more) in a system will cause a large cost reduction for operational mission rehearsal systems. Potential cost reduction for a system is 50 to 80 % of a current systems hardware cost.

PHASE I: Provide a report describing the proposed concept and a system implementation of an affordable photo based image generator.

PHASE II: Demonstrate a prototype image generator running photo-based images on a CRT and Helmet Mounted Display (HMD).

PHASE III: Transition the high performance Image Generator to a military mission rehearsal simulation system.

COMMERCIAL POTENTIAL: An expanding commercial use of image generators into the home game market, travel market and aircraft flight simulator market is expected. Commercial trainer applications into automobile simulators, train simulators, fire fighting simulators (virtual reality market) all expand as photo texture based system arrive.

N95-143 TITLE: Cordless Visual Display Technology for Virtual Environment Applications

OBJECTIVE: Develop digital hardware technology to produce a cordless, high resolution, lightweight, full color, head-coupled display for use in virtual environment applications.

DESCRIPTION: The dominance of the visual channel in human perception indicates the importance of head-mounted display technology to virtual environment research. Applications such as naval simulation and training are limited in their capabilities by display technology. Although the fidelity of display technology has been increasing regularly, an effort has not been made to eliminate the cords thus freeing the wearer of a connection to external equipment. Therefore, the technology development called for includes the elimination of all cords to the display as well as general display improvements. There are three primary technologies presently in use for stereoscopic displays in virtual environment research. For applications in which the operator cannot wear a physical device, a flat-screen stereoscopic display is used. A recent alternatives been to mount the display on a counter-balanced arm allowing the display to be heavier than a typical head-mounted display (Bolas, et al., 1994). In both boom-mounted and head-mounted displays, the display itself has been either LCD or CRT based. Technologies for cordless devices include infrared sensors and optoelectronics (Ward, et al., 1992). Current needs and requirements call for a cordless, high resolution(minimum of 1000 lines of resolution) display which is lightweight, full color, with a high field of view (greater than 100 degrees). The display should also be reconfigurable as view replacing (opaque) or view augmenting (transparent). Head-mounted displays are physically coupled to the head and an external tracking system to follow head movements. Therefore, in compliance with the cordless requirement, a proposed solution must provide for integration with the signal generated from a cordless tracking device.

PHASE I: Provide a thorough investigation of current solutions and develop a design which addresses the needs and requirements listed above. A report describing the proposed solution, its technical improvements over past solutions, and its expected performance specifications will be required.

PHASE II: Develop, test, and demonstrate the solution described under the Phase I effort.

PHASE III: Produce the system developed under the Phase II effort for general purpose applications.

COMMERCIAL POTENTIAL: High resolution, high field of view, stereoscopic display technology is applicable to all forms of virtual environment research. The cordless improvement will enable a wider range of applications to be pursued which have been excluded to this point by technology constraints. The integration of cordless displays with cordless tracking facilitates applications such as firefighter training which are currently hampered by the state of the technology.

REFERENCES:
1. Bolas, MT., I.E. McDonnell, and. Mead. (1994). "Design Background for BOOM Viewers - A Family of Application Specific Head-Coupled Displays." Proceedings of SIP 1994 Conference 2177B - The Engineering Reality of Virtual Reality. 2. Ward, M., Azuma, R., Bennett, R., Gottschalk, S., & Fuchs, H (1992). A Demonstrated Optimcal Tracker With Scalable Work Area for Head-Mounted Display Systems. Proceedings of the ACM 1992 Symposium on Interactive 3D Graphics.

N95-144 TITLE: Six Degree of Freedom Tracking Devices for Virtual Environment Applications

OBJECTIVE: Develop digital hardware and software technology to enable cordless, long range, high fidelity six degree-of-freedom tracking in virtual spaces by human operators.

DESCRIPTION: Six degree of freedom tracking devices are a critical component of virtual environment systems in that they allow direct manipulation interaction between the human operator and virtual objects within the space. Virtual environment training problems, such as firefighter training require a large operating radius and low interference without the use of cords. In addition, virtual environment simulation problems, such as electronic warfare systems evaluation require high accuracy and sampling rates. The most common method currently in use is magnetic tracking which tracks the position and orientation of a receiver within a magnetic field. This can also be achieved through mechanical tracking which determines position and orientation through the relative positions of the joints in a mechanical arm. Other techniques include ultrasonic tracking, inertial tracking, and optical tracking (Ward, et al., 1992). Current needs and requirements call for a cordless system with a long range of operation (minimum ten foot radius). It must be lightweight, accurate, and insensitive to metallic interference enabling possible future shipboard use. Lastly, the device must have a low latency providing a high sampling rate. A proposed solution complying with the cordless requirement must provide for integration with a video signal as would be used in a head-mounted display.

PHASE I: Provide a thorough investigation of current solutions and develop a design which addresses the needs and requirements listed above. A report describing the proposed solution, its technical improvements over past solutions, and its expected performance specifications will be required.

PHASE II: Develop, test, and demonstrate the solution described under the Phase I effort.

PHASE III: Produce the system developed under the Phase II effort for general purpose applications.

COMMERCIAL POTENTIAL: A six degree of freedom tracking system as described would be applicable to all virtual environment applications including those in the medical field as well as scientific visualization. The aforementioned firefighter training example extends beyond military use into all types of firefighter training.

REFERENCES:
1. Ward, M., Azuma, R., Bennett, R., Gottschalk, S., & Fuchs, H. (1992). A Demonstrated Optical Tracker With Scalable Work Area for Head-Mounted Display Systems. Proceedings of ACM 1992 Symposium on Interactive 3D Graphics.

N95-145 TITLE: Thermal Stability Enhancing Additive for JP-5 Fuel

OBJECTIVE: Development of an additive that will increase the stability of JP-5 fuel at elevated temperatures without deteriorating the performance of the fuel.

DESCRIPTION: Future generations of gas turbine engines for naval aircraft and missile application have strong requirements for high specific thrust ratios and low specific fuel consumption. In order to meet these goals, gas turbine engines must operate at significantly higher temperatures and pressures. Currently used JP-5 fuel (narrow cut kerosene jet fuel) will oxidize prematurely at the elevated temperatures anticipated in the new turbine engines. Additive technology exists that will extend the elevated temperature stability of jet fuel but does not stabilize the fuel at the very high inlet temperatures expected. Also, such technology deteriorates other performance properties of the fuel such as water-shedding ability, low temperature characteristics, filterability, and ignition quality.

An innovative additive development effort is required to address the problem of premature oxidation of the fuel due to the high temperatures expected in future generation gas turbine engines. The additive must be compatible with JP-5 fuel in that it does not degrade the important properties of the fuel. In addition, contaminant pickup from shipboard CuNi aviation fuel systems has been shown to degrade the thermal stability of JP-5 and must be addressed in the development.

PHASE I: Efforts should demonstrate the stability enhancing chemistry necessary for high temperature JP-5 performance.

PHASE II: Covers the formulation of doped JP-5 fuel and demonstration of high temperature stability improvement over undoped fuel.

PHASE III: The contractor will scale up the production of the additive formulation in PHASE III for marketing to fuel suppliers as a NAVAIR-approved additive package for JP-5.

COMMERCIAL POTENTIAL: The new additive technology will be applicable to all kerosene based fuels for enhancing both thermal stability and storage stability. Commercial gas turbines will operate at higher temperatures also.

N95-146 TITLE:Energy Dissipation Characterization and Design Methodology for Composite Materials

OBJECTIVE: To develop energy dissipation characterization methodologies for composite material/laminate characterization and design of aircraft certification representative structure.

DESCRIPTION: Energy Dissipation approaches to composite material characterization and design offer the potential to significantly reduce the cost and schedule associated with composite materials for advanced Navy platforms. This technology utilizes energy methods to characterize composite material/laminate energy dissipation under multi-axial loading conditions, better representing actual composite material structural response in both the linear and non-linear regions. The extensive data generated by this approach provides improved material/laminate characterization for use in finite element modeling and design of composite structure. This program will assess current composite material characterization methodologies and evaluate/develop proposed methodologies for use in composite materials and structural development.

PHASE I: Evaluate energy dissipation methods compared with currently accepted composite material/laminate characterization and design methodologies. Develop an approach for certification methodology development and perform an analysis of benefits when fully implemented.

PHASE II: Develop and demonstrate the analytical certification methodologies which support the application of this technology for advanced air vehicles. Validate the attributes of the technology in terms of performance, cost and schedule. PHASE III: Apply this technology for certification of representative demonstration components.

COMMERCIAL POTENTIAL: This technology will be able to be put into practice on commercial aircraft and will provide an avenue for continuing the U.S. lead in advanced composites.

REFERENCES:
1. P.W. Mast, J.G. Michopoulos, L.W. Gauss and R. Badaliance, "Dissipated Energy Density Characterization of Composites", NRL.
2. P.W. Mast, G.E. Nash, J. Michopoulos, R.W. Thomas, R. Badaliance and I. Wolock, "Experimental Determination of Dissipated Energy Density as a Measure of Strain-induced Damage in Composites", NRL/FR/6383-92-9369, April 17, 1992. ADA250322

N95-147 TITLE:Water Crash Dynamics and Structural Concepts for Naval Helicopters

OBJECTIVE: Determine the hydrodynamic response characteristics of Naval helicopters during sudden water penetration associated with crashes at sea. Based on the determination of impact pressure and force distribution time histories on typical hull shapes, develop potential structural concepts and associated requirements necessary to be used as a design tool for achieving water impact survivability. Crash deceleration time history data required for on-board crash sensor calibration and energy absorbing seating will also be defined.

DESCRIPTION: The Navy operates a fleet of approximately 1500 helicopters, all of which include substantial over-water missions. Nearly 90% of crashes for some Navy helicopter types occur into water. Though ground and barrier impact characteristics are very well understood through U.S. Army and automotive research, extremely little is known about water crash dynamics. As a result, no crash criteria (other than low severity ditching) or design approaches exist for the Navy, or civil, water impact threat. This effort will use pre-existing computer simulation codes to predict water impact response properties of typical helicopter hulls suddenly penetrating into water. After validating predictions, this information will then be used to determine crashworthiness subsystem requirements and potential structural concepts for providing survivability under water crash conditions.

PHASE I: Use currently available computer simulation programs, such as KRASH and/or CFD codes, to predict water impact response properties of typical helicopter hull shapes penetrating into water throughout a range of typical impact conditions. Determine pressure and force distribution time histories, as well as vehicle kinematic response. Develop a preferred developmental approach and determine the technical merit and feasibility of this approach. Evaluate the extent to which Phase II results would have the potential to yield a product or process of continuing importance to DoD and the private sector.

PHASE II: Design/manufacture prototypes and validate computer predictions through scale model and sectional drop testing into water. Obtain measured pressure and force levels, as well as kinematic responses, to compare predicted and actual results. Based on validated results, determine deceleration time histories required for calibration of onboard subsystems such as crash sensors and energy-absorbing seats. The end product of Phase II will be a determination of structural requirements to be used as a design tool for managing water impact forces in future Naval helicopters.

PHASE III: Apply the results of the SBIR effort to crashworthy products intended for use by the U.S. Government and the private sector. The Federal Aviation Administration (FAA) will be able to establish water impact criteria for civil helicopters as a result of this effort.

COMMERCIAL POTENTIAL: In addition to helicopters, the results of this effort can be applied as a base for other applications including lightweight aircraft.

REFERENCES:

1. MIL-STD-1290 & Aircraft Crash Survival Design Guide (USAAVSCOM TR 89-D-22A)

N95-148 TITLE: In-Situ Advanced Fiber Placement and Processing

OBJECTIVE: To develop, optimize and implement advanced fiber placement using in-situ consolidation for composite structures. Demonstrate the certifiability of the technology, develop a repeatable process and characterize the advantages of the process for composite material applications. Develop and demonstrate an advanced in-situ fiber placement head design which can be scaled-up to full scale aircraft fiber placement applications

DESCRIPTION: In-situ fiber placement is the next logical step in advanced fiber placement technology applicable to staging thermoset materials and consolidating thermoplastic or thermoplastic/thermoset hybrid composites. This innovative technology provides the promise to automate the composite lay-up and consolidation process to eliminate/minimize post-processing via autoclave. Also, this process provides significant opportunity for unitizing composite structures via fiber placement over substructure w/o adhesive bonding.

PHASE I: Develop and evaluate innovative approaches to advanced in-situ fiber placement heat application/control and consolidation. Develop proposed concepts and design approaches for fiber placement head design to produce repeatable, cost effective certification representative aircraft and missile composite structure.

PHASE II: Design and build an optimized in-situ fiber placement head for subscale demonstration. Demonstrate process performance and characterize process parameters for applicability to primary composite structure. Evaluate the critical aspects of the materials processed using this innovative approach and recommend process/material enhancements for further development and scale-up.

PHASE III: Demonstrate the reproducibility of the process and evaluate the structural performance of a prototype system addressing critical Navy concerns.

COMMERCIAL POTENTIAL: Significant potential to change the paradigm of the composite manufacturing process.

REFERENCES:
1. Advanced Research Projects Agency
2. Great Lakes Composites Consortium

N95-149 TITLE: Advanced Induction Welding of Composites with Out-of-Plane Reinforcement

OBJECTIVE: Develop concepts for improved primary structural bond strengths using advanced induction welding and joining of composites via out-of-plane reinforcements. Demonstrate the performance of inductively welded composites with out-of-plane reinforcement for use in certification representative structure. Analyze the cost, weight and performance benefits when applied to Navy aircraft.

DESCRIPTION: Induction welding of advanced composites offers the potential to significantly reduce the cost and weight of advanced Navy aircraft and missile systems. This technology, through the minimization or elimination of fasteners offers payoffs such as weight, cost, aerodynamics, observables, fuel sealing, lightening strike etc. The basic induction welding technology utilizes susceptor screens in the bondlines to locally heat thermoplastic films which melt fuse to the substrates to be joined. Incorporation of out-of-plane reinforcements in this bondline could provide significant improvements in joint strength, minimizing the requirements for a large joint surface area in structural applications. This technology shows significant promise in terms of enhanced bond strength over conventional approaches. The incorporation of reinforcements out-of-plane offers the potential for significant improvements over the current state-of-the-art. This program will provide the foundation for truly unitized composite structure.

PHASE I: Develop advanced joining technology for composite primary structures minimizing the need for fasteners through reliable, certifiable joints. Innovative approaches to improve bond strengths as feasible alternatives to current bolted structure will be evaluated. Demonstrate concept feasibility to substantiate phase II process development and demonstration for representative application.

PHASE II: Demonstrate subscale applications of preferred approaches and develop analysis and certification methodologies as well as assess benefits for aircraft structure.

PHASE III: Implement and validate the technology on advanced demonstration articles representative of production hardware.

COMMERCIAL POTENTIAL: Significant payoff for commercial aircraft as well as non aerospace applications.

N95-150 TITLE: Composite Material Design and Manufacturing Assessment for Advanced Navy Aircraft and Missile Systems

OBJECTIVE: To identify the cost and performance trade-offs associated with the introduction of improved composite materials systems and manufacturing methods in aerospace structures.

DESCRIPTION: Historically, the development trend in the advanced composites community has been towards stronger, stiffer, tougher materials. These trends have been realized through the introduction of new high performance fibers, and toughened matrix systems. However, increased emphasis on low-cost weapons systems requires cost/performance trade-offs associated with these various composite materials and manufacturing methods be identified in advance of production.

PHASE I: Identify advanced airframe structural composite components and their cost and performance drivers. Identify candidate materials systems representative of various levels of maturity, performance, and cost. Perform preliminary cost/performance trade-offs associated with candidate materials systems, candidate manufacturing methods, and candidate structures. Develop a concept for a model to evaluate material performance/cost/selection trades.

PHASE II: Expanded Phase I activities to include alternate manufacturing approaches and complexity of structural application. Develop a model for cost/performance modeling of composite materials, processes, and structures.

PHASE III: Cost/performance model implementation for commercial aviation and infrastructure.

COMMERCIAL POTENTIAL: Cost/performance models are of interest to those seeking to develop and apply advanced composite materials in commercial and industrial markets where cost is a much greater driver than performance.

N95-151 TITLE: Test and Evaluation Tool for Calibration and Dynamic Testing of Manikin Systems

OBJECTIVE: Current calibration methods of manikin systems primarily consists of static measurements. The manikin system, however, is utilized to evaluate dynamic loads. The objective of this research topic is to develop a test fixture to facilitate short duration, dynamic testing and systems-level calibrations of an anthropomorphic manikin vertebral column/head complex. This dynamic calibration capability is essential for repeatability of test results from one test series to the next, and is particularly important for accurate and fair evaluation of life support systems.

DESCRIPTION: During the initial stages of an ejection, an aviator can be exposed to injurious levels of acceleration along his or her spinal column. Accordingly, fractures of the lower thoracic and upper lumbar vertebrae have been recognized as one of the most dominant major injuries which occur during ejections. Over the years, advanced anthropomorphic test devices have been used to estimate the potential for spinal injury. Typically, prior to testing, these devices are assembled from an inventory of pre calibrated components. The development of a calibration fixture to evaluate the systems-level biofidelic performance is desirable to improve the predictive consistency of the device. The fixture must be capable of providing accurate and repeatable excitations sufficient to produce reliable calibrations. Additionally, the fixture must possess the versatility to conduct short duration, dynamic studies of aircrew interaction with various seating and restraint systems.

PHASE I: A feasibility study shall be conducted which details the conceptual design, analysis, and proof of concept.

PHASE II: A fully functional prototype test/calibration fixture shall be developed which fulfills the Phase I objectives. Refine the prototype hardware and deliver preproduction units.

PHASE III: The developer shall implement the capabilities and technologies learned for the specific Navy use and transfer this technology for use by other DOD and government agencies including the U.S. Air Force and Department of Transportation.

COMMERCIAL POTENTIAL: This effort has commercial applications in the automotive testing community.

REFERENCES:

1. Buhrman, J. R., "Vertical Impact Tests of Humans and Anthropomorphic Manikins," Air Force Armstrong Aerospace Medical Research Laboratory, Wright Patterson AFB, Interim Report, Report No. AL-TR-1991-0129, 1991. ADA245866

N95-152 TITLE: Reflective Coating for Aircrew Helmets

OBJECTIVE: To develop and field a coating for aircrew helmets that can replace the combination of paint and reflective sheeting that is currently in use in the U.S. Navy/Marine Corps.

DESCRIPTION: During search and rescue (SAR) operations, it is desirable to have the aircrew as visible as possible in order to expedite recovery. Currently, the main component seen by SAR aircraft is the helmet, especially if the downed aircrew member is in water. This is due to the white reflective tape that is applied to the helmet, in accordance with OPNAV Instruction 3710.7 (General NATOPS). Currently, Scotchlite® brand reflective sheeting is used (560/580 Series). This tape is applied over the paint that is applied during the manufacturing process. The taping process is extremely labor intensive, requiring 4-6 hours of labor by maintenance personnel. Due to cutbacks in personnel, it is desirable to develop an improved manufacturing process. The helmet must retain 100% reflectivity when wet and be durable enough to withstand the environment during normal use (salt air, humidity, scuffing, exposure to oils and hydraulic fluids). The coating must be capable of touch-up and cleaning without presenting any hazard to the wearer, maintainer, or the environment. This coating must be able to meet the reflective requirements specified in Federal Specification L-S-300C and coating requirements of MIL-C-46168D(ME). Application of the coating should not significantly effect the time or cost of production of the helmet.

PHASE I: Provide a technical and industry survey of current coatings that could be used or describe what steps must be taken in order to develop such a coating.

PHASE II: Use off-the-shelf technology or develop technology necessary to demonstrate the feasibility of coatings identified in Phase I.

PHASE III: Produce coated aircrew helmets for full operational testing and provide necessary data for introduction of coating into the Navy supply system.

COMMERCIAL POTENTIAL: New coatings developed can be used in a variety of applications, from road signs through painting of vehicular helmets for increased visibility under low light conditions. This coating, if flexible, may also prove useful in the marking of other equipment, such as life vests and rafts, used by boaters and aircrew in both military and commercial markets.

REFERENCES:
1. MIL-C-46168D(ME), Federal Specification L-S-300C

N95-153 TITLE: CFD Analysis of Rocket Plume Effects on Ejection Seat Aerodynamics

OBJECTIVE: Wind tunnel testing has shown that the ejection seat rocket plume can significantly influence the aerodynamic behavior, especially at high angle-of-attack. These effects are compounded by multiple nozzle seat systems anticipated for the next generation of ejection seats. The prediction of the aerodynamic effects of the rocket plume is required for six-degree-of-freedom models for calculation of g-loads on the crewmember, ejection trajectory, and design of propulsion systems leading to improved emergency escape performance. Computational fluid dynamics (CFD) methods are needed to investigate rocket plume effects on the aerodynamic forces and moments acting on an ejection seat. The rocket plume model must take into account the effects of free stream Mach number, altitude, and nozzle exit thrust and/or flow rate. The model shall include the ability to evaluate a multi-nozzle configuration with arbitrary thrust levels over a wide range of free stream orientations, through Mach 1.5.

DESCRIPTION: Advances in computational processing capability have allowed CFD methods to become a cost-effective alternative to wind tunnel testing for analysis of complex flow fields. Given the ejection seat and occupant geometry, a computational domain shall be established of the surrounding flow field and rocket motor plume region. Consideration shall be given to the grid size and relative accuracy and convergence properties.

PHASE I: Provide a feasibility study by investigating the state-of-art in prediction of axi-symmetric rocket nozzle plume flows. Develop a Navier-Stokes CFD model and validate the prediction method against experimental data of a simplified fore body geometry. Develop a scheme to allow for a multi-nozzle configuration with modulating thrust levels.

PHASE II: Extend analysis to include a 3-D ejection seat configuration with multiple, variable thrust nozzles over a range of free stream conditions and orientations. Conduct limited wind tunnel tests to verify results. Conduct an extensive validation of the core solving routines.

PHASE III: A validated CFD code will be produced that will be applicable to a wide variety of applications in the military, space, and commercial sector. A simplified user interface shall be established and well documented so that a wide variety of systems can be evaluated. A library of components shall be established such as aero vehicles, seat systems, aerodynamic stabilizers, and propulsion devices shall be established to aid the user in grid generation.

COMMERCIAL POTENTIAL: Any work to improve a CFD model is transferable to other models. Combustion engines in heavy equipment, race cars, civilian aircraft jet engines, etc., can benefit from an improved understanding in the heat transfer or multi-phase investigations aided by computational fluid dynamics methods. Material coating processes (high velocity oxygen fuel (HVOF), vacuum plasma (VP) spray guns would be another commercial application.

REFERENCES:
1. Reichenau, David E.A., "Aerodynamic Characteristics of a Half-Scale CREST Ejection Seat at Mach Numbers from 0.6 to 3.0, July 1988, AEDC-TR-88-6, AD-B123323.

N95-154 TITLE: Day/Night Ship Mounted Aircraft Approach and Landing Imaging Sensor

OBJECTIVE: To develop an imaging sensor capable of functionally replacing the Navy's existing obsolete visible recovery sensor.

DESCRIPTION: The Navy currently utilizes an Integrated Launch And Recovery Television Surveillance (ILARTS) System to simultaneously monitor launch and recovery operations. The system consists of six cameras of two different types. Three cameras are of interest. Two are mounted in the deck on the approach centerline positioned to cover the ranges of the optical touchdown point. The other camera is mounted on the island and can view approaches, deck operations, and launches. The in-deck cameras provide the Landing Signal Officer (LSO) with glideslope and lineup information. The cameras use Intensified ISOCON technology that is no longer available. The cameras mounted in the deck view the aircraft through a 150 mm lens (f3.5) and an optical relay system consisting of a telerelay lens, folding mirror and window assembly. The window and mirror are housed in a ballistic enclosure that has a 15/16 inch high by 2 inch wide opening. These cameras must provide good imagery day and night which is exacerbated by the fact that aircraft approach with the landing lights on (a single 450 watt lamp). The aircraft itself is only illuminated by natural light. The interscene dynamic range is 10E6. Present technology cameras, such as those utilizing ISIT technology, exhibit unacceptable blooming at distances closer than 1500 feet. Other problems include: afterburners washing out images in low light levels, scintillation noise from the intensifier being always present, and long operational periods of 1624 hours reducing the life of the camera. The sensor must meet the following requirements: detect an aircraft at 5 nm, determine position relative to glideslope at 3 nm, identify aircraft type by either signature detail or light pattern at 1 nm.

PHASE I: Provide a design for a sensor that will be capable of meeting the requirements. The design should include a performance analysis and hardware description.

PHASE II: Develop and produce a breadboard sensor system that would demonstrate the required performance. The sensor will undergo an extensive landbased evaluation.

PHASE III: Integrate the sensor into the Navy's ILARTS system and evaluate the fully integrated operational system on a Navy ship

COMMERCIAL POTENTIAL: This technology has application in the private sector in the areas of general surveillance especially where a large dynamic range is required such as when the sun would be in the sensor's field of view and when intense light sources such as automobile headlights would be present in an otherwise totally dark area. This technology could also be utilized in the commercial home video market.

REFERENCES:

1. NAVAIR 516081 Technical Manual, Operation and Maintenance, Instructions with Illustrated Parts Breakdown, Integrated Launch And Recovery Television Surveillance (ILARTS) System.

N95-155 TITLE: Electric Energy Absorber System (EEAS) for Aircraft Recovery

OBJECTIVE: To develop an advanced electric aircraft recovery system for both the Navy sea based and Marine Corps land based fixed wing aircraft.

DESCRIPTION: The future aircraft proposed for the Navy and Marine Corps exceed the present MK 7 MOD 3 and E28 arresting systems' capabilities. The present systems rely on hydraulics to absorb the energy of the aircraft. The MK 7 MOD 3 is a linear device that is heavy, inefficient, and large. The MK 14 was developed as a rotary device that saved weight and volume, but relied on hydraulics for energy absorption. In light of the advances made in power electronic and control technologies, an electrical system offers a more reliable, controllable, and efficient approach. The Electric Energy Absorber System (EEAS) is needed to recover all the fixed wing aircraft of both services. The EEAS will provide a means of electrically arresting the aircraft and retracting the arresting cable, all with the same electrical device. Basically, the EEAS is an energy absorber that will absorb the kinetic energy of the aircraft by electrical means. And, because of the inherent high level of controllability of electrical power, the arrestment can be precisely controlled throughout the stroke, providing less stress to the airframe, thereby extending the airframe life.

PHASE I: During PHASE I, the contractor shall determine the optimum electrical absorbing device for an aircraft arresting application based on a tradeoff study. The contractor shall then proceed with a conceptual design of the entire EEAS based on the optimum device.

PHASE II: The contractor shall provide a detailed design of the EEAS. The contractor shall also provide a working scale hardware model of the EEAS, not less than 1/4 scale, energywise.

PHASE III: A transition to a 6.3 effort by the contractor will provide a full scale EEAS, capable of arresting loads representative of aircraft weights and landing speeds.

COMMERCIAL POTENTIAL: EEAS technology can be used as a high power electric dynamometer for testing of gas turbines, steam turbines, and electric motors. The technology can also be applied as a braking device for locomotives.

REFERENCES:

1. NAVAIR 515BCA1.1, VOLUME 1: TECHNICAL MANUAL; Operation, Maintenance and Overhaul Instructions; Aircraft Recovery Equipment MARK 7 MOD 3

N95-156 TITLE: Anti-Reflective Coatings for Aviation Helmet Visors

OBJECTIVE: Develop a coating to be applied to aircrew visors to decrease reflections seen by aircrew.

DESCRIPTION: As mission requirements placed on U.S. Navy/Marine Corps aircrew increase, the limits of the equipment used become more apparent. Aircrew note that glare, due to reflections both from the visors in front of the eyes and from other sources, decreases their ability to successfully complete the mission. It would be desirable to reduce the amount of reflective glare seen by the aircrew. This could be accomplished through the use of an anti-reflective coating applied to the visor lens. These coatings are to be applied to visor systems currently in use on USN/USMC aviation helmet systems. These visors have a spherical segment profile, are made of polycarbonate, and have a scratch-resistant coating. Sources must provide expected measures of performance; for example: transmissivity, weight of coating (per unit area), glare reduction, method of application, support requirements, etc. The coating must be able to withstand the environment associated with USN/USMC helmet systems (salt air, humidity, scratching, exposure to oils and hydraulic fluids), must not degrade either the integrity of the visor material, or the optical performance, and must be durable. It is desirable that the coating be field repairable if minor scratching occurs.

PHASE I: This phase should consist of a study of the coatings available and the methods that would be used to apply the coating. The study should address all areas of concern as described above and show the feasibility of the coating.

PHASE II: This phase should use the materials and processes outlined in Phase I to prepare a sufficient number of visors for laboratory and flight testing to determine user acceptability and performance.

PHASE III: Production and commercialization of effort.

COMMERCIAL POTENTIAL: Polycarbonate lenses are widely used in commercial activities, such as: eyeglasses, protective eyewear, motorcycle helmet visors, aircrew helmet visors. Any coating developed could be effectively used in all of these areas.

REFERENCES:

1. MIL-V-85374(AS)

N95-157 TITLE: Compact, High Power, Quick Reacting Storable Energy Sources.

OBJECTIVE: The objective of this project is to develop a compact source of electrical power which is capable of long term inert storage.

DESCRIPTION: The proposed project will examine electrical generation and storage technology to develop a safe and reliable alternative method of providing electrical power. Military applications of these devices are primarily in weapons or missile targets. In these applications, the devices are installed in the weapon/target at the time of manufacture. They remain inert through the shelf life of the weapon, and are activated only when the weapon is fired. The device must then immediately begin to provide electrical power sufficient to operate the weapon's/drone systems. It must maintain sufficient power throughout the weapon or target time of flight.

PHASE I: Phase I will require the developer to examine the state of the art in electrical storage technology. The objective in phase one will be to develop a PRACTICAL method of power generation which can achieve the rapid rise time of a thermal battery after prolonged storage, and sustain sufficient output for the entire time of flight of a typical missile or target. The storage device will provide a practical alternative to current technology. The device and the electrical generation process must be able to fit within the physical boundaries of the missile or drone and, in operation, must not adversely impact the vehicle systems.

PHASE II: During phase II, the developer will package and test the power generation system for use in aerial targets and/or missiles.

PHASE III: In the third phase, the system will be integrated into a selected target system identified in Phase II and tested.

COMMERCIAL POTENTIAL: The ability to provide electrical power from an in-circuit device that is inert and storable until use would find commercial application in many areas, particularly for emergency relief. As an example, in emergency lighting systems, or as power for emergency communication systems. In earthquake response kits electrically operated devices could be included without the current constraints of battery shelf life.

N95-158 TITLE: Modeling Characteristics for Volumetric Explosives

OBJECTIVE: Develop a model for evaluating Fuel Air Explosive (FAE) reactions based on the detonation parameters for particulate clouds.

DESCRIPTION: The conditions affecting whether a FAE cloud will sustain a steady state detonation include the material properties, dispersion parameters, initial boundary conditions, and initiation source. These include, in particular fuel chemical composition, particle size distribution, particle shape distribution, surface to volume ratio, particle solid density; fuel and oxidizer concentrations and cloud diameter; ambient temperature, pressure, and humidity; and, initiation source type, duration, and location. These are among the parameters which determine the rate of energy release and the total energy released from the reaction of a FAE cloud.

PHASE I: Assemble the parametric equations and data necessary for constructing the model. Identify and assess modeling techniques/approaches appropriate to this problem. Select the approach to serve as the basis for Phase II based on these findings.

PHASE II: Develop a model which utilizes detonation parameters and which allows for the varying of input parameters (e.g. fuel type, etc.) to evaluate FAE reactions. Complete a final report detailing the model.

PHASE III: The model will be transitioned to the government. It is expected that the contractor will provide written documentation, assistance and consultation necessary for installing the model on government computers and support necessary for government users to begin operating this model.

COMMERCIAL POTENTIAL: This model has application in the private sector to industrial hazards and accidents involving solid particulate explosions.

N95-159 TITLE: High Energy Density Fuels for Solid Fuel Air Explosives (FAE)

OBJECTIVE: Develop techniques for laboratory scale production of fine coatings on reactive metal powders to be used in volumetric explosives.

DESCRIPTION: Current enhanced blast volumetric explosive fuels have particle sizes ranging from 15 to 45 microns (μ). New processing techniques have enabled the production of solid particulates in sizes of approximately one to three μ with a variety of coatings. Current production capabilities can provide material quantities on the order of grams (g). Laboratory experimentation to characterize reactive powders with coatings for use as solid fuels in explosives and propellants requires quantities on the order of tens of pounds.

PHASE I: Identify processing techniques for producing μ size coated particulates. Assess their applicability for the production of reactive metal powders of interest as solid fuels. Identify facilities which could provide laboratory scale-up production. The contractor is to provide a report identifying processing techniques and facilities available for producing reactive metal powders.

PHASE II: Develop a detailed understanding of the coating process, including the effects of coating reactive metal and/or binder concentration, particle size, and coating thickness. Develop a process and design of scale-up facilities for the continuous or batch production of useful quantities of metal fuel particulates. Provide 100g to 500g (or larger) samples of a variety of very fine reactive metals coated with a number of different metals or binders for safety and performance evaluations at NAWCWPNS, China Lake. Complete a final report describing the process and analysis on the materials.

PHASE III: Evaluate the performance and the producibility of the materials for practical explosive applications. Conduct toxicity assessment on the optimum material. Transition to production level scale-up and processing.

COMMERCIAL POTENTIAL: Weaponization involving reactive metals with coatings will require facilities capable of pilot or full-scale production processing. Activation/pacification of small particulates with coatings could have potential application in several industries from pharmaceuticals to metallurgy.

REFERENCES:

1. C. Gotzmer, W. Felder, R. Gill, K. Harrity, *Preparation of Reactive Boron Powders*, presentation Naval Surface Warfare Center/White Oak; W. Felder, *Vapor Coating of Boron Particles by Magnesium*, AeroChem Research Laboratories, Inc. AeroChem TP-479, Contract No. N60921-88-C-0134, Draft Copy, December 1988, prepared for Naval Warfare Center/White Oak;
2. W.T. Rawlings, R.R. Foutter, T.E. Parker, *High Temperature Ignition of Coated Boron Particles in a Shock Tube*, Final Report, Contract No. N60921-91-c-0188, Physical Sciences Inc., PSI-2176/TR-1171, February 1992.

N95-160 TITLE: Passive Techniques To Eliminate Combustion Instabilities

OBJECTIVE: The objective is to develop passive techniques to change the natural acoustics for a given combustor. Ramjet engines will be emphasized, but this work can apply to industrial burners, turbines or any combustor.

DESCRIPTION: Combustion instabilities are an extremely complex phenomena which cannot be accurately modeled. They are often, however, associated with the natural acoustics of the ramjet engine. If energy is added at a pressure node of the natural acoustics, then the acoustic energy is increased leading to combustion instabilities (Rayleigh criteria). Modifying the natural acoustics of the engine could allow control over combustion instabilities since the pressure nodes could be moved away from the energy source.

PHASE I: Phase I will be a feasibility study. A detailed literature review on the attenuation and regeneration of sound in straight ducts and curved ducts needs to be conducted. Existing knowledge must be expanded and applied to ramjet environments where mass flowrates, temperature and gaseous reactants affect the natural acoustics. Passive techniques which alter the longitudinal and transverse modes of the ramjet will be modeled and evaluated for testing.

PHASE II: Phase II will consist of testing the proposed techniques in combustion environments, though initial tests may be noncombustive. Ultimately, the passive techniques will be tested for their ability to change a high amplitude oscillation in one mode to a low amplitude oscillation in a different mode. Testing must occur for center dump and side dump combustor configurations to evaluate the robustness of the passive techniques. Data on combustion efficiency and pressure loss must be analyzed to determine if there are adverse affects on overall combustor performance.

PHASE III: Phase III will contain engine performance mapping for a simulated mission. The top performing passive techniques from Phase II will be tested and compared to results without the passive technique. Combustion efficiency, pressure recovery, lean blowoff and combustion instability measurements will be compared.

COMMERCIAL POTENTIAL: The ability to change the natural acoustics of a combustion chamber has direct application to industrial burners for noise reduction or performance enhancement by eliminating instabilities. The technology may also lead to better acoustic manipulation for noncombustive systems, such as airconditioning and heating ducts.

REFERENCES:
1. Basic Considerations In The Combustion Of Hydrocarbon Fuels With Air, National Advisory Committee for Aeronautics, Report 1300, Chapter VIII, Oscillations In Combustors, 1959.
2. Combustion Instabilities in LiquidFuelled Propulsion Systems, Advisory Group For Aerospace Research & Development, AGARD Conference Proceedings No. 450(AGARDCP450). ADA211109
3. Air Force Wright Aeronautical Laboratories, Ramjet Combustor Instability Investigation: Literature Survey and Preliminary Design Study, by R.C. Waugh, et al. United Technologies Chemical Systems, San Jose, Ca., September 1983. (AFWALTR832056 Vol. 1, report UNCLASSIFIED.)
4. Clark W.H. and Humphrey, J.W., Identification of Longitudinal Acoustic Modes Associated with Pressure Oscillations in Ramjets, Journal of Propulsion, Vol. 2, No. 3 MayJune 1986.
5. Byrne, R.W., Longitudinal Pressure Oscillations in Ramjet Combustors, AIAA/SAE/ASME 19th Joint Propulsion Conference, Seattle, Washington, June 2729, 1983 (AIAA832018).

N95-161 TITLE: Pulse Width Modulated Valves for Liquid Fuel Control

OBJECTIVE: The objective is to develop an inexpensive, compact, digitally controlled fuel valve for use with liquid fueled ramjet engines. This work may also apply to other airbreathing propulsion engines, such as turbines, pulse detonation engines and scramjets.

DESCRIPTION: Good performance of a liquid fueled propulsion system for a wide range of operating conditions requires a means for metering the fuel flow to the engine. This has been accomplished in the past by an electromechanical cavitating venture valve, fluidic control valve and other technologies. These valves in general have been high cost, have a high pressure drop and are relatively large. The current state-of-the-art valve fits into a 3" x 4" x 6" box. Gains in liquid fuel missile propulsion performance can be realized with higher density, higher viscosity fuels which become attractive with compact, low cost, lightweight fuel management components.

Pulse Width Modulated (PWM) valves have been developed for the automotive and space industries. PM valves offer the advantage of compactness, in line installation with the fuel line(s) and integrated electronics. Their use in the automotive industry has dictated a need for low costs, low operating pressures (<100 psi) and compatibility with a liquid fuel. Those used in the space industry are generally for pneumatic and hydraulic applications at very high pressure (>3000 psi) with large pressure drops. The operating frequency for these valves has been less than 200 Hz.

The current needs for a ramjet engine require moderate operating pressures up to 500 psi for a maximum fuel flow rate of 11.5 Gam; or for a maximum fuel flow rate of 2.9 gam. If four valves are used in parallel. The pressure drop across the valve should be minimal (<50 psi) at the maximum fuel flow rate. A fuel management system study has shown that a fuel flow rate turndown ratio of 15:1 is needed. The current technology in PM valves offers a metering capability of about 4:1.

A large variation in fuel flow rate delivery to combustor is not acceptable, thus higher operating frequencies or a means of damping the fuel flow perturbations downstream of the valve is needed. This is desired while maintaining a size and cost commensurate with automotive PM valves.

PHASE I: PHASE I will be a feasibility and design study. The feasibility of simultaneously meeting the above needs will be addressed and documented. A design effort will then be conducted to substantiate the feasibility and provide a preliminary design for Phase II. Other issues to be addressed are accuracy, repeatability, method of control and compatibility with JP10 and RJ7.

PHASE II: Phase II will consist of a detailed design effort followed by prototype fabrication and performance testing. Also, testing shall be conducted on the prototype valve to ensure survivability during missile captive carry, launch and flight environments. A limited production run of four units each of a high flow rate valve and ten units each of a lower flow rate valve, will occur after prototype testing has been completed. These valves shall meet the needs specified and agreed to during the preliminary and detailed design efforts.

PHASE III: PHASE III will consist of military production and commercialization.

COMMERCIAL POTENTIAL: The commercial market for PM valves may be expanded through development for this new application, especially if the valves are applicable to the turbine engine industry.

N95-162 TITLE: Weapons Quality Q-switched Laser

OBJECTIVE: The objective of this project is to design, fabricate, and test a Q-switched solid state laser which will meet the requirements for a weapon system while maintaining a low cost per device.

DESCRIPTION: Laser initiation for advanced warhead applications requires the use of Q-switch technology to achieve initiation rates comparable to exploding fail initiator and exploding bridge wire devices. Most existing Q-switch technology is unsuitable for ordnance systems applications due to cost and complexity considerations. Active systems (electro-optic, acousto-optic, rotating mirror devices) increase the size, complexity and cost of the laser system beyond the practical limits for a one shot costly, and preclude the option of plating an output coupler directly to the laser rod. The laser system should be rigged enough to meet military specifications for vibration, operating temperatures, and prolonged storage without requiring optical adjustment.

PHASE I: Develop preliminary design approaches and evaluate feasibility.

PHASE II: Design and demonstrate prototype devices. Design goals are:

- Laser should survive 50 shots at maximum power without degradation.

- Laser should survive MILSTD810 testing without loss of alignment.
- Device should be capable of 15 yr. shelf life
- Performance and shelf life should not degrade with exposure to temperature extremes (55C to 160C)
- Peak power density: >5 MW/mm^2
- Pulse duration: <20 nsec
- Cost in quantities >100: not to exceed $200 each

PHASE III: Transition to military ordnance community. Determine interest in medical/surgical community and industrial applications.

COMMERCIAL POTENTIAL: A device meeting the above specifications would have immediate application in industrial laser processing, including cutting, welding, heat treating, drilling, cladding, surface alloying. Medical applications are rapidly evolving as well.

REFERENCES:
1. L. C. Yang, Vincent J. Menichelli. "Detonation of High Explosives by a Q-switched Ruby Laser.: Journal of Applied Physics, Vol. 45, No. 6 (June, 1974), pp 26012608.

N95-163 TITLE: <u>3-Dimensional Perspective Transformer at Video Rates</u>

OBJECTIVE: Develop an image processing engine to perform 3D perspective transformations of imagery at video rates.

DESCRIPTION: Navy air-to-ground targeting, usually requires the operator, to detect the target from a mission planning asset that is nothing more than a hardcopy of a picture. In many instances pilot workload becomes an overriding factor, and there is not ample time to find the target. Many human factors studies have shown that by warping the imagery (rotating, scaling, translating etc.) to the perspective of the human operator we can decrease the time required to perform the targeting function, while increasing targeting effectiveness. At present there exists hardware to perform 2D warping of imagery at RS170 video rates. There is talk in the TACAIR community about storing imagery in the Digital Map System (DMS). With this imagery and an elevation database one could vastly improve Air-to-Ground targeting effectiveness.

PHASE I: Outline the system requirements, establish what resources will be required to perform realtime 3 axis warping of imagery, and produce an initial system design and execution plan on paper.

PHASE II: Build a prototype 3 axis warper based on the Phase I results.

PHASE III: Integration of the 3 axis warper into our realtime image processing facilities.

COMMERCIAL POTENTIAL: Includes commercial aircraft, train and automobile trainers and simulators, as well as medical imaging applications.

REFERENCES:
1. "Digital Image Warping" Wolberg 1990 IEEE Computer Press

<u>**NAVAL SEA SYSTEMS COMMAND**</u>

N95-164 TITLE: <u>Develop Test Concepts and Techniques to Quantify the Free Field Safety Level of RF Induced Body Currents and RF Burn in Humans</u>

OBJECTIVE: Develop test concepts which can be used to measure the amount of induced RF current that would flow through a human body when immersed in a RF field. Test concepts should also address the current flow through the wrist when grasping rigging in a high RF field. It is also desirable that test concepts be developed that would address the likelihood that a person would receive an RF burn resulting from contact with metallic items located in a high RF field. The frequency range of interest is .003 to 100 MHz, RF current range is 0 to 250 ma. Test concepts should be capable of being performed by personnel in a naval ship environment, in port and at sea, as well as on land. Test time aboard ship is a major attribute.

DESCRIPTION: Naval ships contain a large number of high power transmitters in a limited amount of real estate causing areas of high RF environments which creates a radiation hazard (RADHAZ) safety problem to personnel. These high environments limit personnel activities associated with the operation of naval ships. There is also a large quantity of metallic rigging which captures the RF energy thus causing a potential radiation hazard safety situation when grasped or touched. ANSI/IEEE C95.1-1992 contains limits for induced body current through the feet/ankles for free standing persons and current through the hand/wrist in a grasping situation. There is no criteria for RF burn. The Navy utilizes 140V as a indicator of RF burn potential.

PHASE I: Develop at least 4 possible test concepts by which the sought after measurements can be obtained. Develop a performance baseline for these concepts and perform those trade off studies necessary to define the preferred test concept.

PHASE II: Develop/procure the necessary hardware for measuring the RF induced current for both ankles and wrist as well as RF burn if addressed in phase I. Develop the necessary validation criteria which will be used to verify that the test concepts and equipments measure the RF currents that would be induced into a human. Execute the test at the Naval Surface Warfare Center Dahlgren Division, Dahlgren, Va.

PHASE III: The successful results of phase I and II will transition to the Ship Electromagnetic Compatibility Improvement Program (SEMCIP) managed by SEA 03K23. Funding will be provided to procure the necessary hardware and execute Radiation Hazards Certification of naval ships. SPAWAR 10 will transition results for RADHAZ certification of shore sites. Should any new equipment be developed the contractor will be the source for procurement as well as responsible for training government/contractor personnel in the utilization of the test equipment and test concept.

COMMERCIAL POTENTIAL: The ANSI/IEEE C95.1-1992 is applicable to both government and commercial establishments which install/operate RF transmitting equipment, i.e. hospitals, communication companies, radio stations, security firms.

REFERENCES:
1. American Conference of Governmental Industrial Hygienists(ACGIH), "Threshold limit Values (TLVs) and Biological Exposure Indices for 1992-1993," 1992.
2. American National Standards Institute (ANSI) C95.2-1981, "American National Standard Radio Frequency Radiation Hazard Warning Symbol," 1981.
3. Institute of Electrical and Electronics Engineers (IEEE) C95.3-1991, "IEEE Standard Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields-RF and Microwave," August 21, 1992.
4. MIL-STD-882C, "System Safety Program Requirements," January 19, 1993.
5. Institute of Electrical and Electronics Engineers (IEEE) C95.1-1991, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," April 27, 1992.

N95-165 TITLE:Develop and Produce a Real-Time Ultrasonic Weld Evaluation System

OBJECTIVE: Develop automated ultrasonic inspection system to perform real-time weld evaluation.

DESCRIPTION: A 1989 the Navy concluded that, in certain cases, ultrasonics is an acceptable alternative to radiographic inspections. As a result, in accordance with MIL-STD-1688, ultrasonic inspections are now allowed in place of radiographic inspections. Additional savings in inspection costs, along with improvements in quality and reliability could be provided with improved characterization of the discontinuities in the weld metal.

Currently, the Navy (NAVSEA 08) is using ultrasonic systems which automate the data collection process for in-service inspections. The analysis and interpretation of the signatures still requires both post-processing and human interaction, which is labor intensive and requires considerable training. Laboratory research at the Naval Surface

Warfare Center has demonstrated that automatic sizing and classification of the weld discontinuities is now possible with current advances in sizing technology and classification algorithms. Thus, to reduce inspection costs, the Navy requires a real-time system which is capable of automatically sizing and characterizing the discontinuities. Such an automated system will yield improved quality assurance and permit improved acceptance criteria standards reducing the number required inspections and repairs.

Capabilities of this real-time system should support discontinuity detection and sizing, classification of the discontinuity type (ie. crack, lack-of-fusion, porosity, void, etc.), and application of an acceptance criteria. The acceptance criteria should parallel MIL-STD 2035(SH), and incorporate the capability to accept or reject the discontinuity based on: the ultrasonic signature amplitude, size of the discontinuity, proximity of neighboring discontinuities, and the type of the discontinuity. This system must support inspection of hull welds under as-welded conditions, thus the capability for both angle-beam and normal-incidence inspection modes is required. In addition, in order to support transition of technology to the fleet, the system must support in-field manual inspections, whereas the inspector is aided by the equipment to determine the discontinuity size, type and acceptability.

PHASE I: Develop and investigate techniques to perform discontinuity detection, sizing, and classification. Identify limitations of techniques as applied to in-the-field hull weld inspections. Identify automated ultrasonic equipment to support real-time inspections and identify hardware/software interface requirements.

PHASE II: Develop and demonstrate a system on Type I hull welds at laboratory and field trial sites. Demonstration of the system is required for both a manual inspection, and a fully automated inspection in real-time. Develop licensing and commercial production requirements.

PHASE III: Transition the system to the Navy, for example, the Naval Joining Center, and the Naval Surface Warfare Center, where the system can be demonstrated for a wide range of applications.

COMMERCIAL POTENTIAL: This technology has direct application to commercial shipyards, for example, Bath Ironworks, Avondale Industries, General Dynamics, and the piping industries.

REFERENCES:

1. L.M. Brown and R. DeNale, "Computer Assisted Weld Inspection", in Proceedings, 1994 Innovation Symposium, 7-9 September 1994, Pittsburgh, Pennsylvania, American Society of Naval Engineers, pp. 507-517.
2. "Ultrasonic Inspection Procedure & Acceptance Standards for Hull Structure Production & Repair Welds", NAVSEA 0900-LP-006-3010 (Jan 1966).
3. "Nondestructive Testing Acceptance Criteria", MIL-STD 2035(SH)(1991).

N95-166 TITLE: Universal Portable Communicator

OBJECTIVE: Produce an affordable, universal, portable, personal communicator for tactical and administrative intra-ship communications by all Navy shipboard personnel. Device would be used in lieu of current wired shipboard communications systems as last link from sailor to the communications network. Device shall comply with emerging and current FCC standards for narrow-band digital systems, and shall inter-operate on multiple disparate networks. Performance in congested shipboard EMI/EMC environments shall be demonstrated in Phase II. Units must as light weight and low cost as emerging digital cellular and Land Mobile Radio (LMR) products. In addition to voice, unit would also handle data and slow speed video.

DESCRIPTION: Design and produce hardware and software to be hosted in a portable communicator to allow interoperability of a universal communications device within disparate networks.

PHASE I: Analyze Land Mobile Radio, Cellular, and Personal Communication System networks. Determine each systems modulation schemes, operating frequencies, and interface requirements. Interfaces to be addressed include security, including Type I, Common Air Interface (CAI), and Common Network Interface (CNI). Demonstrate portable communicator interoperability with multiple networks.

PHASE II: Determine telecommunications services for all ship to ship, ship to shore, and on-shore links. Establish applicability, survivability, and interoperability links with ship and shore based communications infrastructure. Produce a demonstration model digital wireless communicator compliant with FCC standards operable in the congested shipboard EMI/EMC environment.

PHASE III: Demonstrate transfer of voice, data, and video information among disparate networks. Demonstrate operations in a small scale joint Military exercise.

COMMERCIAL POTENTIAL: Industry could use a universal portable communicator within the commercial infrastructure of disparate Land Mobile Radios (LMR) and cellular systems.

N95-167 TITLE: Develop System for Gas Turbine Duct Noise Cancellation

OBJECTIVE: Attenuate airborne gas turbine and ventilation fan system noise transmitted through intake and exhaust ducting to critical ship spaces.

DESCRIPTION: Develop a noise cancellation system suitable for both quieting a variety of duct configurations and shipboard compartment arrangements. Demonstrate active noise cancellation at a gas turbine facility.

PHASE I: Develop a realtime simulation model/design tool of a noise cancellation system to demonstrate noise attenuation throughout spaces in a ship and system design approach, respectively. Compare the model results with current shipboard practices.

PHASE II: Design, develop and test a prototype noise cancellation system based on the accomplishments of Phase I. Demonstrate noise cancellation on 3MW (or greater) gas turbine intake system at either a commercial or government facility. Revise the design tool and simulation model and prepare documentation for their use. Develop ship system implementation design and cost benefits analysis for a destroyer class vessel.

PHASE III: A successful prototype is expected to be incorporated into the next new Navy ship design. Final design development and testing shall take place in Phase III to ensure performance in a Navy shipboard environment. The noise cancellation system shall be develop to withstand corrosion, vibration, shock and EMC/EMI environments as well as demonstrate reliable operation. The offeror is expected to participate with the ship designer and builder for the final design of the noise cancellation system.

COMMERCIAL POTENTIAL: This technology would have application in commercial building ventilation systems, automotive compartment comfort, mobile land based offices and facilities, and basically any enclosure requiring noise attenuation without the use of passive treatment systems. The advantages of reduced material acquisition, simplified construction, reduced weight, reduced volume are all applicable to both the commercial sector as well as military systems.

N95-168 TITLE: Develop a Low Cost Fiber Optic Switch

OBJECTIVE: Develop low cost, reliable, and easily manufactured multimode fiber optic switches by using arrays of micromachined switching elements.

DESCRIPTION: Optical communications and sensor systems are planned for future use on Navy ships such as AEGIS cruisers. The Fiber Optic Data Multiplex System needs rugged 2X2 multimode switches to bypass nodes for shipboard use. Current relay type optical switches experience transient upsets during physical shocks that lead to signal loss. Low loss solid state switches are not available for multimode optical fiber systems. Hence, optical switches utilizing arrays of moveable mirrors based on micromachine technology would be more shock insensitive than current relay type optical switches and still have low losses. This technology has been demonstrated in the coupling of light into laser cavities.

PHASE I: Design and demonstrate a concept for producing multimode, broadband fiber optic switches. The design should demonstrate beam steering between and input optical fiber and two output optical fibers using a micromachined mirror array.

PHASE II: Optimize switch design for use in the Navy SAFENET Optical Communications System. Construct several prototype 2X2 non-latching optical switches utilizing micromachined mirror arrays. Perform temperature, shock and vibration characterization of candidate switches. Establish procedures for economical mass production of switches.

PHASE III: Transition to the Fiber Optic Base Technology Program. Construct a ruggedized switch for laboratory testing followed by sea trails in a SAFENET application.

COMMERCIAL POTENTIAL: Multimode fiber optic switching is currently a slowly developing market sector because of the difficulty in reliably producing quality switches. Micromachine manufacturing processes would streamline multimode fiber optic switch manufacturing, increase switch reliability, and reduce switch costs. The Micromachine Mirror technology has applications in 1XN switch designs and, control of laser diode alignment and laser cavity tuning.

REFERENCES:
1. MilSpec 24725.

N95-169 TITLE: Magnetic Bearing Shock

OBJECTIVE: Demonstrate capability of magnetic bearing system technology to operate through MILS901, Grade A, shock impact within minimal volume constraint.

DESCRIPTION: Develop, design, produce and test a three bearing single rotor system (two radial, one axial) to demonstrate operation through a shock environment and limits of operation in loss of levitation. The magnetic bearing system should be design with the intent of eventual development for aircraft and aircraft derivative gas turbine engine application. Disseminate the technical information to the design community.

PHASE I: Design a three bearing single rotor system, levitation and controller that can be scaled up for a 5000 lb rotor. Develop a simulation system to evaluate the performance of the system under preshock, shock, and post shock operation.

PHASE II: Develop a magnetic bearing rotor system for shock evaluation. The suspended rotor weight shall be greater than 500 lbs. Demonstrate operation of the bearing system through a MILS901 Shock. Revise the design tools and the simulation model based on shock evaluation. Prepare simulation model and related technical information for dissemination.

PHASE III: Design, build and test a magnetic bearing system for a nominal 30005000 Kw generator rotor that may be suitable for marine application. Install the magnetic bearing in a commercial generator set for extended evaluation.

COMMERCIAL POTENTIAL: There is not expected to be a lot of commercial potential for shock worthy magnetic bearing system designs. This is a primarily military requirement that must be satisfied in order to consider magnetic bearing technology for naval platforms. However, the limited commercial applications may include critical applications such as a vibration-less feed of machining/milling operations, and also for handling tools used by numerical control machines.

REFERENCES:
1. MIL-S-901

N95-170 TITLE: Develop Electric Starter Motors for Ship Propulsion Gas Turbine

OBJECTIVE: Develop an advanced motor, e.g., variable reluctance motor, etc., and associated electronics as a starter for an advanced ship propulsion gas turbine.

DESCRIPTION: Ship propulsion turbines are currently started by air motors energized from a high pressure (HP) air system. Electrically energized starter motors would significantly reduce the requirements and cost of shipboard air systems, improve system reliability, and reduce start times over those resulting when several other ship equipments must be started before the turbine.

The starter motor design should consider those factors that affect the design of potential power sources such as battery banks and small (under 500 KW) generator sets. The starter motor shall have a nominal rating of 270 horsepower. More specifically, it must have the following speed torque characteristics: 1) speed range of shaft 0-2800 rpm, torque 500 lbs.-ft (constant), horsepower as determined by speed-torque; 2) speed range of shaft 2800-4600 rpm, torque as determined by speed-torque, horsepower 270 (constant). The air motor currently used has a maximum rotor speed of 22,000 rpm and gears down the shaft speed to those mentioned above. The air motor is 11.89 inches long (including gear) and has a diameter of 9.73 inches. The electric motor (including any necessary gearing) must have a similar diameter, but may be as long as 21.25 inches (The extra length is obtained by removing the HP air piping feeding the air starter). The ambient temperature can range from 32^{o}F to 190^{o}F. The motor must be capable of surviving a 30g shock and have a mean time between failure (MTBF) of at least 20,000 hours. Other performance requirements, e.g., duty cycles, turbine coupling, mechanical and mounting arrangements, etc., will be provided by NAVSEA.

PHASE I: Develop the design of a full scale starter; identify required power, cooling air, wiring, power supplies, etc., prepare drawings, parts lists, etc. At the end of phase II, starter specification should be sufficiently complete to begin manufacture in the next phase. Provide report.

PHASE II: Manufacture prototype starters to the phase I design. Manufacture 2 units, first to be a functional brassboard model, second to be a pre-production prototype. Both units must be fully functional to allow testing of the starter concept and unique features. The starter will be evaluated on a ship propulsion gas turbine now in development. Provide report.

PHASE III: Conduct full scale testing, correct deficiencies, procure ILS and transition to production.

COMMERCIAL POTENTIAL: The advances in motor technology, in power semiconductor technology, and digital controls make this application challenging but achievable.

REFERENCES:
1. Technical Specification, SP-92-006, WEC, 15 October 1992.
2. Schell, Joseph A., “Alternative Gas Turbine Starting Systems”, CDNSWC-TM-27-91-32, May 1992.
3. Ferreira, C.A., and Eike Richter, “Detailed Design of a 250-kW Switched Reluctance Starter/Generator for an Aircraft Engine”, SAE Technical Paper 931389.
4. Radun, Arthur, and Eike Richter, “A Detailed Power Invertor Design for a 250 kW Switched Reluctance Aircraft Engine Starter/Generator”, SAE Technical Paper 931388.
5. Radun, Arthur, James P. Lyons, James Rulison, Peter Sanza, Eike Richter, Dynamic Testing of a High Power Invertor 250kW Switched Reluctance Machine Starter/Generator, presented to SAE in April 1994.

N95-171 TITLE: Develop Improved Electronic Classroom Human Interfaces

OBJECTIVE: Research new/emerging technologies to increase the training efficiency by improving the human interfaces of the Electronic Classroom.

DESCRIPTION: NAVSEA fielded electronic classrooms that introduced new technology into the traditional classroom environment. This new technology came from computer, communication, and multimedia fields. It did not have a human interface component. The gains achieved by the Electronic Classroom will only be maximized when the human interface also benefits from advancements in technology.

PHASE I: The contractor will investigate man/machine interfaces specifically dealing with computers and communications systems. The research will focus on methods to improve the interface that will have a direct benefit on efficiency of the Electronic Classroom. The contractor will develop prototype hardware and/or software to test areas of greatest potential efficiency.

PHASE II: The contractor will install and test in the Electronic Classroom environment those prototype hardware and/or software outputs of Phase I that are judged viable. The contractor will modify these products as required by the unique requirements of the Electronic Classroom environment and the continuing state-of-the-art technology advancements. Metrics will be established and data collected to determine relative efficiency gains in the Electronic Classroom from employment of this technology.

PHASE III: Those products of Phase II that are judged to be cost effective will be identified to the Office of Training Technology (OTT) in the Chief of Naval Operations (Office N7) for consideration for Navy-wide implementation. The Chief of Naval Education and Training (CNETT) will be appraised of results for use in the Navy school-house environment. The contractor will assist in implementation of selected products in additional Navy Electronic Classrooms over and above those tested in Phase II. Copies of all reports/evaluations will be forwarded to the OSD level for potential tri-service/inter-governmental/private sector utilization.

COMMERCIAL POTENTIAL: The advancement of the Electronic Classroom through improving the man/machine interface will benefit anyone with a training requirement that can use this technology. Training is a requirement of industry, government, and the military. The need to improve the efficiency of training is shared by all.

REFERENCES:

1. Course Reduction Demonstration Project Final Report, Navsea 04Mp 10/92

N95-172 TITLE:<u>Develop Improved Solid State Neutron Detector</u>

OBJECTIVE: Develop a solid state device which measures neutron intensity at background levels.

DESCRIPTION: Develop hand-held solid-state based neutron detector for portable instrumentation. The unit should be no larger than 2" diameter and 8" long with a detector area no larger than 4" by 4". The unit should operate for at least 40 hours with 2 D-cell batteries. The unit should detect background neutron radiation at an intensity of 0.01 milliREMs per hour within one minute of operation. The prototype unit may be a stand-alone unit for demonstration purposes. The ultimate goal is to operate the probe with the Multifunction RADIAC system.

PHASE I: Develop a preliminary design for a solid state device which measures neutron intensity at background levels, and conduct research to confirm that topic design objective will met.

PHASE II: Construct prototype detectors for use with Multifunction RADIAC System.

PHASE III: Develop production model for Navy use. This will be the transition to production phase.

COMMERCIAL POTENTIAL: This device will be useful to commercial nuclear power plants and commercial site restoration businesses.

REFERENCES:

1. Fabrication Specification for the Multifunction RADIAC System.

N95-173 TITLE:<u>Develop Passivated Pyrophoric Metal Powders</u>

OBJECTIVE: Eliminate the fire and explosion hazards associated with handling dry pyrophoric powders, such as Hafnium (Hf)

DESCRIPTION: Material Safety Data Sheets on many dry metal powders such as Hafnium (Hf) indicate possible fire and explosion hazards especially when handling in particle sizes below twenty microns in diameter. Research at NSWC labs on coating such metal powders with various polymers and plasticizers demonstrated desensitization in air, however, abrasion of the coatings occurred when mixing in propellants and explosives resulting in sensitive energetic compositions. The offeror's proposal should describe or exhibit an understanding of significant aspects of this problem and propose techniques to passivate that do not abrade, such as surface nitridation and metal microencapsulation. Of interest are the desensitization techniques and experimentally measuring the level of desensitization via established hazards tests such as electrostatic discharge tests (ESD).

PHASE I: Effort should be directed towards experimentally proving the feasibility that Hf powders can be desensitized via nitridation and metal microencapsulation or other techniques that do not abrade. Experiments may be carried out at the one gram or less scale. ESD tests may be accomplished by NSWC.

PHASE II: Effort should further develop the desensitizing techniques and experimentally verify the desensitizing effect. Particle size effects may also be explored. Fifteen kilograms of the desensitized Hf powder should be forwarded to NSWC for evaluation in energetic compositions during Phase II. Phase II effort should gather the chemical engineering data necessary for scale-up in Phase III to large quantities of the desensitized Hf powder and extension to other metals.

PHASE III: Military applications that would benefit from this technology are broad and encompasses propellants, explosives, pyrotechnics and reactive materials.

COMMERCIAL POTENTIAL: Industries that are interested in the technology for new abrasives, new intermetallic preparation techniques, production of dry metal powders for industrial use. Microencapsulation could lead to new catalysts at less cost.

REFERENCES:
1. MSDS on Hafnium powders: R. H. Nielsen, "Hf and Hf Compounds", Kirk-Othmer Encyclopedia of Chemical Technology, 3rd Edition, Vol. 12, John Wiley & Sons, NY, 1980, pp 67-80.

N95-174 TITLE: Develop a Fuel Fume Environmental Recovery System (FFERS)

OBJECTIVE: Recover the fumes from conventional fuel that are emitted from ships’ fuel tank vents, returning the fumes to liquid state into the tanks, thereby eliminating the fume emissions, preventing the explosive risk and conserving the fuel energy. This technology is applicable to military, merchant, and commercial fuel transfer operations.

DESCRIPTION: Ships store conventional fuel in enclosed tanks, some or all of which are vented to the atmosphere. Whenever ships received, offload or conduct internal transfers of fuel, the vents emit noticeable fumes. When receiving fuel, the transfer rate is such that substantial fumes are emitted resulting in hydrocarbon air pollution, severe risk of fire, and loss of potential fuel energy. A mechanism to recover the fumes and return the hydrocarbons to liquid state is needed for considerations of environment, energy and fire risk. The means to recover fumes could be either part of the fueling delivery apparatus, such as on the fueling pier, or inherently added to the ship. In the case of Navy ships which routinely send and receive fuel while at sea and daily conduct internal transfers of fuel, the preferred mechanism would be a shipboard system. The purpose of the fuel fume environmental recovery system (FFERS) would be to collect and condense the fumes, conduct necessary filtering, processing, or cooling, and return the fuel to storage tanks.

PHASE I: The technology to collect, recover and condense fumes in a large volume, high flow rate shipboard environment would be developed. Design considerations would need to ensure FFERS would not diminish the ship’s design fuel transfer rate and would meet the requirement to maintain the fuel below the Navy’s minimum acceptable flash point of 140 degrees Fahrenheit. Some technology may be transferred from the low pressure, low volume gasoline vapor recovery mechanisms now being used at some automobile gas stations. Determine the specific classes of U.S. Navy and MSC ships that could utilize FFERS, including Nuclear powered ships, which carry conventional fuels. Define the system capability parameters since each class of ship will have different fuel capacity and transfer rates, which drives a variety of FFERS models. Design the system capabilities to comply with the most stringent Environmental Compliance Regulations of Air Pollution currently in U.S. ports, and to enable measurement of the quantity of recovered fuel.

PHASE II: Develop the prototype(s). Conduct testing and Navy approval of a prototype. Install the unit onboard a ship. Conduct import and at sea testing to include receiving, off-loading and internal transferring of fuel.

Upon initial successful evaluation and refinements, install further prototypes either on all ships in a particular class of ship or all ships in a particular port. Conduct analysis to determine the fuel costs savings incurred and the amount of air pollutant emissions averted. Further develop prototypes and/or installations for other Navy ships

PHASE III: Conduct further development of models for other Navy and MSC ship classes. Advance the development of the system to enable further applications, as follows: 1) Shore based military aircraft refueling operations, 2) Shipboard aircraft refueling (fixed wing, jet and helos), 3) Shipboard fueling of small boats and landing craft, 4) Ship fuel pump machinery rooms, collection of fumes incident to leaks, and 5) Ship paint and mixing rooms, collection of paint and solvent fumes.

COMMERCIAL POTENTIAL: This technology has commercial potential for seaport refueling operations, airport fueling operations, large scale liquid transfer operations at refineries and petrochemical plants in high air pollution areas, and hazardous spill cleanup operations.

N95-175 TITLE:Develop an Expendable, Gun-Launched Observation Vehicle

OBJECTIVE: Develop and produce an expendable payload-carrying observation vehicle and demonstrate flight after a 15,000-g launch acceleration and 7,000-g rebound deceleration typically experienced in launch from a 5' Naval gun.

DESCRIPTION: This SBIR topic seeks to develop an expendable, gun-launched, observation vehicle (OV). The OV shall be compatible with smooth barrel, tube-launched systems, such as mortars, and rifled systems, such as guns or howitzers, for bore sizes of 120 mm, 5 inches and 155 mm. Sabots or sleeves may be used to adapt the 120 mm OV to larger bore sizes. Regardless of bore size, the total handling length of the OV shall not exceed 30 inches with a total weight not to exceed 35 pounds in the 120 mm diameter configuration. The design of the OV and the materials used for its construction shall be optimized to maximize payload capacity and vehicle strength while minimizing parasitic weight and vehicle signature (audio, visual, RF and infrared).

The OV may the launched with or without rocket assist. The design of the base of the OV shall be adaptable to this form of propulsion and shall be capable of cleanly separating form this interface. The OV shall be fitted with a low drag nose shape and a self-starting, power plant which will sustain the vehicle in a loiter pattern at 10,000 feet altitude for a minimum of 3 hours. The power plant may be nose or tail mounted and shall provide a minimum of 100 watts of power continuously for the entire time of loiter.

The gun launched version of the OV shall utilize a government supplied control actuator system (CAS), inertial measurement unit (IMU), GPS receiver (GPS/Rx), two-way communication link (COM link) and sensor package (SP). The payload section of the OV shall contain the SP, COM link, GPS/Rx and IMU. It is highly desirable that the payload section be configure as one continuous volume which may also include the nose cavity, if not discarded. This section shall have a minimum volume of 120 cubic inches with a maximum load capacity of 10 pounds. Non shock-hardened (model grade), actuators and inertial sensors may be used for initial airframe tests which do not involve gun launch.

The nose of the OV may be discarded for the purposes of allowing forward-looking sensors a clear optical path or to permit the OV's power plant to function properly. The deployment of aerodynamic control and lifting surfaces shall be reliable and performed with as little disturbance to the OV's flight path as possible. Once all surfaces have been deployed, the OV shall possess adequate lateral and longitudinal (stick-free) stability so as not to require stability augmentation from an autopilot. The OV shall include a flight management system (FMS) containing all the software and hardware necessary to stabilize the airframe and navigate the OV, exclusive of the GPS/Rx and IMU. The FMS shall be capable of receiving and processing data from the government supplied GPS/Rx and IMU.

The OV shall be capable of reliable operation after the application of a 15,000 Gs set back acceleration pulse (8 ms wide) in line with the longitudinal axis. Lateral and set forward accelerations shall be 3,000 and 7,000 Gs, respectively. The unit production cost goal in quantities of 2,000 is $5,000, not including the control system.

PHASE I: (Concept Study): Phase I shall be final report describing theory of operation, estimated performance and the technical risks associated with the proposed design for phase II statement of work.

PHASE II: (Risk Reducing Hardware Demonstrations): The output of this program shall be hardware demonstrations including flight tests and other technical documents which verify the predicted performance. The

Phase II test program shall include significant risk reducing demonstrations of the OV airframe and its components (hardware and software) through the gun launch environment.

PHASE III: (Form, Fit and Function): The anticipated Phase III effort will be the advanced development or engineering development phase of a naval surface fire support program to develop a gun launched, over-the-horizon targeting and battle damage assessment capability for the Navy or Marine Corp.

COMMERCIAL POTENTIAL: The potential of rugged, expendable aircraft is particularly valuable in fighting forest fires and emergency response to hazardous material accidents

N95-176 TITLE: Develop an Expendable Video Data Link

OBJECTIVE: Develop a small, rugged, data link (including antennas) to compress and transmit digital video signals from an expendable airborne observation vehicle to a Naval ship. Demonstrate operation after a 15,000-g acceleration adn 7,000-g rebound deceleration typically experienced in launch from a 5' Naval gun.

DESCRIPTION: A low cost data link is a key component of many sensor concepts to provide targeting for Naval Surface Fire Support. Unlike aircraft, UAV, or missile sensors, gun-fired sensors must be much lower cost and smaller, and their data links must be similarly small. Also, a key advantage of the gun is its fast response, and data links that require long setup periods are self-defeating.

The data link desired for this topic would be capable of being gun launched as part of an observation vehicle with a video camera sensor, and transmit this video back to the firing ship from a distance of 50–100 miles. The camera would be either a commercial-quality CCD imager (768x494 pixel, 24 bit color), or a lower resolution infrared imager. Two observation vehicles are under consideration: a parafoil with ten-minute mission time, and a winged vehicle with a three-hour mission time. Line of sight to the ship would be maintained with a gun-launched relay similar to the observation vehicle, without its sensor but with room for a larger transmitter or more power. Only point-to-point operation on a dedicated channel is required—networking is not. Minimizing the cost of the expended projectile is the primary concern, even if the cost of the shipboard receiver is increased. The targets will be primarily tactical battlefield targets like artillery batteries, infantry positions, logistic sites, vehicles, and landing zones. The sensor must support single frames at full resolution but lower frame rate to support identification and battle damage assessment. A desirable capability would be to allow the operator to designate areas of interest that will be transmitted at higher quality with the background at lower quality. The observation vehicle will be equipped with GPS and an inertial navigator. The data link may make use of these components, for example, to provide timing and synchronization, or to assist in video compression by providing knowledge of camera motion.

Key to the design of this data link is the cost tradeoff between data compression and bandwidth. The contractor will make this tradeoff, keeping in mind the mission requirements. Neither the data link bandwidth or the compression technique is fixed. What is desired is effective tactical performance at minimum throwaway cost.

PHASE I: Define system requirements of resolution vs frame rate for the different mission functions (surveillance, reconnaissance, situational awareness, identification, targeting, and battle damage assessment). Establish targets for bandwidth, power consumption, volume and cost. Design the system, selecting compression techniques, data format, and RF signal characteristics.

PHASE II: Construct a prototype and a gun-launchable brassboard. (The contractor will have assistance from the government on gun-launch hardening of electronics) Demonstrate performance against field targets.

PHASE III: Transition would be to a gun-launched reconnaissance and targeting system being considered as a 1997 Advanced Technology Demonstration

COMMERCIAL POTENTIAL: In addition to the obvious commercial applications of mobile data systems, video teleconferencing, and mobile TV cameras, this system would be particularly useful for expendable sensors for fire fighting, hazardous materials accident response, land and sea rescue, and destructive testing.

REFERENCES:

1. Naval Surface Fire Support Study, J. G. Ferrebee, S. E. Anderson, and O. K. Blosser, Naval Surface Warfare Center, Dahlgren Division NWSCDD/TR-92/667, July 1992 provides more background on the operational concept, target set, and operating ranges.

WHY WE ARE PROPOSING THIS TOPIC: Targeting, identification, and battle damage assessment for Naval Surface Fire Support currently relies on non-organic assets such as satellite photography, manned reconnaissance aircraft, and intelligence reports. These assets are not controlled by the NSFS units, are not timely, and are not responsive to the changing battlefield environment. Responsiveness and flexibility are particular advantages of guns in fire support, and are key components of the Maneuver Warfare from the Sea operational concept.

Current data links that have the range needed are much too heavy. (For example, Unisys's Low Cost Interoperable Data Link, for the Short Range UAV, weighs 18 pounds.) However, there is great opportunity to capitalize on the recent advances in video compression and the emerging commercial RF components for the 2 GHz personal communications and wireless data markets.

N95-177 TITLE: Development of Improved Methods for Removal of Conformal Coatings from Electronic Printed Circuit Boards

OBJECTIVE: Develop and deliver easy to use equipment for the removal of conformal coatings from electronic printed circuit boards. This must be designed so as to be suitable for use in the extremely limited space available aboard surface ships and similar environments, and of minimal inherent hazards to personnel.

DESCRIPTION: Electronic printed circuit boards often have an epoxy or similar based coating which seals, covers and conforms to the imbedded or surface-mounted electronic components. Efforts to repair the circuit card by replacing components first requires removal of this conformal coating without damaging the other components of the card. Present methods involve the use of corrosive chemicals or micro-grinders, the substance and residue of which, respectively, poses serious personnel hazards. A new commercial process using micro-abrasive blasters can remove conformal coatings with relative safety but the equipment is far too bulky for use at repair stations aboard Navy ships, military field repair vans and in other locations where space is limited.

PHASE I: Identify the most promising techniques for conformal coating removal in the shipboard environment. Develop a prototype concept demonstration device and conduct tests to verify its capability to perform in the shipboard environment.

PHASE II: Refine the design of the prototype equipment and develop and deliver at least six fully operational systems suitable for an extensive evaluation by operating maintenance sites. At least two of these sites will be on board surface ships, and at least two at Navy Intermediate Maintenance Activities. Provide detailed technical data needed for training of technicians and for the logistic support of the equipment.

PHASE III: A Phase III effort is very probable. This would result in fully engineered equipment for widespread use at both military and private sector repair facilities.

COMMERCIAL POTENTIAL: Current commercial processes are either bulky or yield inherently hazardous risks. The conformal coating removal equipment developed would have a direct wide commercial application at a very large number of electronics repair facilities both in the U.S. and throughout the world. Other sites requiring electronic repairs using equipment suitable for confined locations, such as remote research sites, offshore oil rigs, or space stations, should be explored.

N95-178 TITLE: Develop Customized Training Using Artificial Intelligence Methods

OBJECTIVE: The development of a general purpose platform-transportable authoring system to produce customized training through the use of artificial intelligence procedures. The system should contain an artificial intelligence (AI) interface for student monitoring and its own or a commercial multimedia training program, and be transportable between a family of desktop CPUs.

DESCRIPTION: The Navy provides classroom training but generally lacks training facilities where Navy tasks are performed, e.g., aboard ship or in remote base stations. An innovative training system is sought which can be put on a personnel computer to provide customized training to sailors in performing specific tasks or functions. Artificial intelligence techniques will be used to customize lessons and act as an advisor to the student. The training tool will incorporate multimedia elements such as hypertext, graphics, audio and video. It should model the student and control the manner and level in which information is presented. It should monitor student progress and interactively modify the lesson to emphasize areas of difficulty. Alternatively, it should allow sailors to receive general on-line training in other topics of interest in accordance to their technician background and previous training. The artificial intelligence interface may be developed to work with existing multimedia authoring systems. A graphical user interface should be provided to allow the construction of courses by authors not having computer programming skills.

PHASE I: Investigate and report the requirements for a system meeting the above description and objectives. Design a solution and methodology for solving the problem, emphasizing the artificial intelligence technique, including the Artificial Intelligence interface for multimedia training. Use existing systems, which allow the AI components to be incorporated in a transparent manner, to provide the desired capabilities.

PHASE II: Develop, produce, demonstrate, and deliver a multimedia authoring tool for the creation of customized training. This system must run on a 386-based Personal Computer, and will facilitate the construction of courseware and training materials minimizing the programming skills required of the author. A small training problem will be selected by the Government and the Contractor, and will be implemented with the tool to demonstrate the desired capabilities.

PHASE III: Utilize the authoring tool in creating training courses for specific systems, devices, etc. The AEGIS Training Center would be one possible site. The other services may also use the tool.

COMMERCIAL POTENTIAL: The training products of this effort have broad applicability to the commercial sectors. In example, an on-line intelligent training system could benefit the automatize repair industry due to a wide variety of vehicles serviced. Refresher training produced by this tool can be used by any reasonably sized business to significantly reduce training costs.

REFERENCES:
1. “Multimedia goes on the Job Just in Time”, pg. 39, New Media Magazine, July 1993.
2. “A Guide to Multimedia,” by Victoria Rosenborg.
3. “Handbook of Artificial Intelligence”, Avron Barr and Edward Feogembaun.

N95-179 TITLE: Develop a Unified Architecture for a Real-Time Distributed, Electronic Warfare (EW) Simulation

OBJECTIVE: Design and develop a distributed architecture using Object-Oriented Analysis and Design methodology for live, constructive and virtual Electronic Warfare simulations and visualization real-time data.

DESCRIPTION: Distributed simulation of Electronic Warfare scenarios entails excessive data traffic. Current distributed interactive simulations (DIS) message handling techniques are inadequate. An object-oriented design is needed to reduce the amount of traffic transmitted, transported, received and processed. The design should address the following topics:
(1) The mechanism for maintaining a consistent notion of time throughout a distributed, EW simulation;
(2) A unified, open architecture that will allow different, existing models to be combined seamlessly within the same simulation framework;
(3) Engineering considerations to achieve real-time simulation and visualization when transmission bandwidths and delays may be limited;
(4) Load management and "graceful" degradation of system performance as system saturation is approached.

PHASE I: Demonstration of feasibility of architecture

PHASE II: Delivery of architecture design with documentation

PHASE III: Produce system developed during Phase II

COMMERCIAL POTENTIAL: This activity would advance the technologies involved in the development of a standard interoperability framework. This is to say, it would research mechanisms for communication between unrelated software/hardware implementations. This would provide another capability in the reusable software components commercial industry.

N95-180 TITLE: Develop a Real-Time, Wave Propagation Model for Heterogeneous Clutter Scenes.

OBJECTIVE: Development of a radar wave propagation computer model for heterogeneous clutter scenes to be used in a real-time, distributed, Electronic Warfare computer simulation environment.

DESCRIPTION: Current algorithms for computing non-free space radar wave propagation loss are considerably more time-consuming when accounting for multipath-interference effects. Also, these models are limited to homogeneous clutter scenes. There exists a need for a model to be developed that will allow the user to abstract propagation effects such as atmospheric attenuation, multipath, refraction and diffraction into appropriated levels of detail when desired. The proposed radar wave propagation model should possess the following attributes: Capability to run in a real-time environment; ability to represent heterogeneous clutter scenes such as a land/sea interface or an archipelago (clutter may be represented either empirically or by spatial/temporal statistical distributions); provide for a rationalism to apply clutter models to real-word terrain data (e.g., Digitized Terrain Elevation Data).

PHASE I: Demonstration of feasibility of model

PHASE II: Delivery of computer model with documentation.

PHASE III: Produce system developed during Phase II for general applications

COMMERCIAL POTENTIAL: This activity falls within the context of the Modeling and Simulation community's push toward real-time capability in simulated environments. The type of environments simulated could range from tactical to theater warfare engagements, as well as, FAA air traffic training scenarios. Also, this activity would improve the performance correlation between the simulation and the real-world environments.

N95-181 TITLE: Surf Zone and Craft Landing Zone Obstacle Clearance.

OBJECTIVE: Develop concepts, equipment, and/or techniques to breach transit lanes through defensive (non-explosive) obstacle complexes located in the Surf Zone (0 - 10) and the Craft Landing Zone on the beach. This is a re-advertisement of Topic N94-202.

DESCRIPTION: Technologies may include any mix of explosive or non-explosive techniques. Concepts should emphasize high payoff for rapid obstacle clearance.

PHASE I: Develop and identify potential concepts, means of deployment and cost per system for obstacle breaching mission. Quantify capabilities of each concept.

PHASE II: Demonstrate optimum concept(s) from Phase I study, showing performance objective is achievable and capable of being deployed from existing fleet assets.

PHASE III: Execute full scale system design and build prototypes for developmental and operational test and evaluation. Demonstrate system readiness for initial operational capability by demonstrating acceptable performance, reliability, maintenance, training procedures, and all other logistic support requirements.

COMMERCIAL POTENTIAL: Commercial applications include demolition, rapid debris clearance, site reclamation and support of rescue, mining, and construction operations. It could also be applicable to the reclamation of abandoned industrial, bridge, and wreck sites located in coastal areas.

N95-182 TITLE: Develop Aluminum Stabilization of NbTi Superconducting Wire

OBJECTIVE: To advance the development of methods to co-extrude aluminum as a stabilizer to super-conducting wires and thereby provide wires that can be used in military and commercial magnet systems, e.g., Magnetic Resonance Imaging systems and compact motors.

DESCRIPTION: Superconducting wire is made with a normal metal in intimate contact with the superconductor. The normal metal stabilizes the performance of the superconductor when it is used to make magnets. Copper has been the traditional choice for the stabilizer with the most common superconductor, NbTi. For various reasons, especially light-weight, aluminum is being developed as an alternative to copper. Pieces as long as 6,000' have been made of NbTi wire with an aluminum stabilizer. Many superconducting magnet applications require even longer pieces; however, current machine designs for the co-extrusion of aluminum are reaching their limits in terms of piece lengths. The Navy is interested in fostering the advanced development of machinery that can improve on this piece length.

PHASE I: In phase 1 the contractor will develop design plans for an aluminum co-extrusion machine. The machine will be capable of extruding aluminum onto copper clad superconducting core wires. The ratio of aluminum to the core wire can be as low as 2 to 1 or has high as 10 to 1. The diameter of the core wires can be as small a 0.3 mm and as large as 2 mm. The machine shall be capable of applying the aluminum in a continuous manner to pieces of core wire that can be as long as 100,000' and as short as 2,000'. The application of the aluminum shall not degrade the current carrying capabilities of the core wire.

PHASE II: In phase 2, the contractor will build the machine and use it to produce at least a 50,000' piece length of aluminum stabilized NbTi wire. The core wire shall have a diameter of 0.3 mm, and the ratio of aluminum to the core shall be 3 to 1. The core wire will be a mutifilamentary composite of NbTi filaments embedded in copper. The core wire shall be capable of carrying at least 200 amps at 5 tesla and 4.2 kelvin.

PHASE III: The contractor will also use the machine to produce a second piece of aluminum stabilized NbTi wire. The second piece shall be at least 25,000' in length. The core wire shall have a diameter of 0.8 mm, and the ratio of aluminum to the core shall be 3 to 1. The core wire will be a mutifilamentary composite of NbTi filaments embedded in copper. The core wire shall be capable of carrying at least 1000 amps at 5 tesla and 4.2 kelvin.

COMMERCIAL POTENTIAL: Supper-conducting wire is used to wind the magnets in Magnetic Resonance Imaging Systems (MRI). The wire presently used in MRI magnets requires that the system be cooled with liquid helium. This liquid needs periodic replenishment. Aluminum stabilized superconductors can eliminate the use of the liquid helium. Due to their lighter weight, magnets would with aluminum stabilized super-conducting wire can be conductively cooled with a cryocooler based (liquid helium free) refrigeration system. Eliminating the cost and availability constraints of liquid helium will make MRI systems less expensive and more available for worldwide use, even in remote locations. The design choices that will become part of the Navy's mine sweeping magnet system will become part of any conductively cooled commercial magnet system.

REFERENCES:
1. Superconducting wire is used to wind the magnets in Magnetic Resonance Imaging (MRI) systems. The present wire requires that the system be cooled with liquid helium. This liquid needs periodic replenishment. Aluminum stabilized superconductors have the potential to eliminate the use of the liquid helium. Due to their lighter weight, magnets wound with aluminum stabilized superconducting wire can be conductively cooled with a cryocooler based refrigeration system. Eliminating the cost and availability constraints of liquid helium will make MRI systems less expensive and more available for worldwide use, even in remote locations.

N95-183 TITLE: Design, Develop, and Demonstrate a Low Power Digital Signal Processing Multichip Module for Mine Warfare

OBJECTIVE: Demonstrate a multichip module architecture and technology that offers 50 to 500 million instructions per second (MIPS) at a maximum power consumption of less than 10W. An improved Digital Signal Processor (DSP) is needed to support the high-rate digital signal processing required in the next generation mines that will require the processing of large amounts of acoustic array sensor data through complex algorithms.

DESCRIPTION: Mine development programs need considerable processing power but have limited space and power available. Multichip module technology is rapidly becoming available to meet these needs. In addition to the 100% duty cycle mode at less than 10W a light load mode (10% duty cycle), and idle mode (0% duty cycle, chip power on), and a sleep mode (0% duty cycle, everything off except a low speed clock) shall be available at appropriately reduced power consumption.
Module size should be less than five cubic inches. The ability to handle numerous analog and digital inputs is needed. Sixty four to 256 analog input channels with at least 10 bit resolution needs to be processed and 64 to 256 discrete. I/O bits are also needed. The basic I/O interface can be done on one module with I/O expansion done on another module. One or more RS232-C serial ports are required to support the system and code development. A real-time clock and two system clocks on the module are also required. Power can be 5.0 volts or 3.3 volts but only one supply is allowable. The DSP multichip module is aimed at tasks such as beamforming, high speed correlation and spectral analysis.

PHASE I: Design and develop a multichip module design for a high performance DSP for a mine system. Choose multichip module technology for fabrication.

PHASE II: Implementation of the Phase I multichip module design. Ten samples shall be constructed, debugged, tested and delivered along with complete software operating, development, debug packages with fabrication and software documentation.

PHASE III: Transition DSP to an upgraded mine or new mine development.

COMMERCIAL POTENTIAL: Small, high-performance DSPs are critical to the development of a large variety of commercial products. Large-scale production of low power DSP multichip modules will greatly enhance the equipment price/performance ratio and open new commercial markets for high performance, portable battery-powered equipment.

REFERENCES:
1. Multichip Modules, Johnson, Teng, Balde, IEEE Press.
2. 1993 Proceedings, International Conference on Multichip Modules, International Society for Hybrid Microelectronics.

N95-184 TITLE: Develop a Miniature, Low Power Ocean Bottom Seismometer/Accelerometer (S/A)

OBJECTIVE: Develop a low volume, low power, lightweight, low frequency (0.005-0.25 Hz) ocean bottom seismometer (OBS)/accelerometer for shallow water seismo-acoustic data collection.

DESCRIPTION: A Navy data collection system will need a miniature OBS to be deployed by aircraft in shallow seas. Important parameters are volume (<10 in^3), power (<2 mW), sensitivity (<1 nano-g = 10^{-8} m/s^2), ruggedness, and cost.

PHASE I: Develop sensor design(s) to meet the required parameters. Evaluate design(s) and select most promising for fabrication. Project expected sensor performance of design(s). Concept must be eventually low cost and be able to withstand vibration and shock environments of aircraft delivery.

PHASE II: Fabricate, package, and test six (6) prototype sensors of each design. Evaluate design(s) for weapon incorporation with regard to required parameters. Prototypes should be suitable for field and environmental testing.

PHASE III: Transition prototype to 6.3 program for improved engineering design of data collection system.

COMMERCIAL POTENTIAL: An affordable miniature S/A will find wide commercial use in areas such as geological fault location, oil eploration, earthquake and volcanic warning systems, and nuclear monitoring. The fabrication technology use to build these miniature sensors lowers the cost and greatly improves the ruggedness of the sensor due to the very small size similar to the process of moving electronic circuits from printed circuit boards to integrated circuits.

REFERENCES:
1. "Measurements of Ambient SeaBed Seismic Levels Below 1.0 HZ on the Shallow Eastern U.S. Continental Shelf", Mark V. Trevorrow etal., J. Acoust. Soc. Am., December 1989, p. 2318-2327.

N95-185 TITLE: Develop a Miniature Magnetometer

OBJECTIVE: This program will research and develop a next generation or highly optimized Subgamma Micropower Miniature Magnetometer (SMMM).

DESCRIPTION: Existing sensors have performance limits that do not meet advanced undersea weapons requirements. This work will extend the state-of-the-art for magnetometers. Parameters are < .5mW. power consumption, noise < .1nT., eventual low cost of less than $50 per unit and production units capable of meeting weapon environmental specs.

PHASE I: Examine existing sensors for use in new technology. Develop and provide an innovative SMMM design and indicate its feasibility in laboratory tests or theoretical analysis.

PHASE II: Produce six prototype sensors, using the most promising technology as defined in Phase I. Performance parameters are to be optimized with low cost, and ruggedness considered secondary considerations at this time. Rigorous testing will be performed and the devices will be characterized for production and studied for ruggedization and production cost reduction.

PHASE III: Transition prototype SMMM to an upgraded or new undersea weapon development.

COMMERCIAL POTENTIAL: An advanced SMMM will open new commercial markets in the areas of vehicle surveillance, traffic road sensors, and new Intelligent Vehicle Highway Systems (IVHS) uses. Low cost magnetic sensors would also be used in manufacturing, security, and recycling.

REFERENCES:
1. Gordon, D.I., Brown, R. E., "Recent Advances in Fluxgate Magnetometry." IEEE Transactions on Magnetics, MAG-8, No.1, March 1972.
2. Lentz, J.E., "A Review of Magnetic Sensors", Proceedings of IEEE, Vol. 78, No. 6, June.

N95-186 TITLE: Develop and Produce a Large Screen Color LCD Projection System

OBJECTIVE: Develop and Produce a large screen color LCD compact projection system capable of producing clear, readable, presentations from vibrating platforms

DESCRIPTION: Conduct research to determine the feasibility, limitations and packaging considerations for a color, high resolution liquid crystal display (LCD) projection system that is relatively insensitive to vibration. The system should produce a clear, readable, crisp screen presentation when mounted to a platform that is vibrating. The technology used should be unlimited in its ability to vary the projection size with a nominal target size of 21” to 27” diagonals. The system should provide SVGA graphic quality resolution with consideration given to HDTV as a future application. Economical implementation is an important consideration; therefore, use of off-the-shelf components wherever possible is strongly encouraged. The packaging concept should be the smallest possible depth to permit installation in compact locations.

PHASE I: Develop a large screen color display design, and determine the feasibility of projecting color LCDs onto a variable screen size. Determine the limitations of the technology with respect to resolution, projection elements size, (i.e., LCD size), packaging compactness, particularly depth, and screen blur or jitter due to vibration. Demonstrate the limitations via simple graphics, text and television projections

PHASE II: 1) Build a prototype system using the design(s) proposed in Phase I. 2) Test the prototype to determine its ability to withstand vibration and present a clear, defined, sharp color image. 3) Test the prototype to verify that no resonant frequencies exist in the range from 0 to 25 Hz. 4) Test the prototype to verify that the system electronics are not susceptible to electromagnetic interference (including susceptibility to DC magnetic fields up to 20 Oersteds), are compatible with typical industrial power (115 VAC preferable), does not radiate unsafe electromagnetic emissions in accordance with FCC standards, and does not experience high failure probability due to temperatures between 20 degrees F to 130 degrees F.

PHASE III: Build a production system for installation onboard the New Attack Submarine for use in the ship control station. 1) Prepare level III drawings for the system. 2) Fabricate a cabinet housing three LCD projection systems to fit in a maximum footprint of 96 inches wide by 44 inches deep and 58 inches high. 3) Test the production unit to ensure it has no resonant frequencies from 0 to 25 hz, that it can operate reliably in temperatures from 20 degrees F to 130 degrees F, that it passes EMI per MIL-STD-461, that it survives shock amplitudes of 10Gs, and that it is compatible with shipboard type I power as defined in MIL-STD-1399.

COMMERCIAL POTENTIAL: This technology has the potential to become the next generation movie theater projection system and the next generation home television, particularly for HDTV and the information superhighway. The LCD element can be projected onto varying screen sizes with controlled loss of resolution to reduce the cost of the overall system dramatically, making a projection screen color television affordable to the average American and drastically reducing the cost of expensive movie theater projectors while simultaneously making them compatible with other media planned for the information superhighway.

REFERENCES:

1. FCC standards
2. MIL-STD-461
3. MIL-STD-1399

N95-187 TITLE: Develop a Miniature Diode Laser Velocity Sensor

OBJECTIVE: Develop and produce two-component backscatter miniature Laser Doppler Velocimetry (LDV) probes utilizing commercially available visible laser diodes, avalanche photodiodes, and miniature optical components. The size and power requirement of these probes will allow LDV to be used on small, autonomous, battery-powered Navy test vehicles.

DESCRIPTION: The LDV measurement technique has unique characteristics including it's non-intrusiveness, fast response, and high accuracy. However, the size, power requirement, complexity, or cost or standard LDV measurement systems often makes them impractical for many fluid velocity measurement tasks. Replacing ion gas lasers and photomultipliers with visible diode lasers and avalanche photodiodes results in a significant cost and an even greater electrical power and component size reduction. Several important LDV applications for Navy research are on hold until a small low power LDV prove can be developed. These applications include but are not limited to: 1) propeller inflow measurements on maneuvering, battery powered research vehicles, and 2) time series measurements of flow seen by an individual propeller blade, whereby the effects of wake unsteadiness on propeller performance are measurable.

PHASE I: Develop components and design alternatives for a two-component backscatter diode laser velocimetry probe. Produce six waterproof working prototype probes for evaluation by the Navy. The diameter and the overlength of the entire miniature LDV probe (including two transmitters and their receivers) for the two diode lasers must not be larger than 25 mm and 200 mm respectively.

PHASE II: Explore techniques to add laser beam frequency shifting or its equivalent to the diode laser based sensor developed in Phase I and to add a family of miniature LDV probes with various sizes, frequency, power, and focal lengths.

PHASE III: Refine manufacturing techniques to increase robustness of the probes and to lower instrument costs. Produce and sell a commercial product that can be used with available LDV signal processors and software from other LDV equipment manufacturers.

COMMERCIAL POTENTIAL: LDV instrumentation is currently a good business for several instrumentation manufacturers. Small, low power, probes with completely self contained optics would open up many new application areas for LDV. There has been quick adoption (over the past 5 years) of fiber optic links between large high powered optics systems and small rugged probe sensors. This shows that the instrumentation market is looking for ways to simplify and miniaturize the LDV technique. The diode laser and avalanche photodiode based system envisioned would enclose the entire optics system inside a rugged, waterproof probe as small as fiber optic LDV probes. The component costs of a diode laser probe compare favorably to the ion gas laser, photomultipliers, and fiber optics of conventional LDV systems.

REFERENCES:
1. Coughran, M. and D. Fry, "Expected Capability of Multiple - Probe LDV Propulsor Inflow Measuring System", CDRKNSWC/HD-1308-01, Feb. 1990. ADA220778

N95-188 TITLE: Develop Stealthy Materials for Moving Systems in the Sail of Submarines

OBJECTIVE: Develop and provide stealthy, quiet, low observable structural materials for applications to masts, housings and sensors used for optical, ESM, and communication purposes.

DESCRIPTION: Current submarine planning places great emphasis on stealth. Moving parts in submarine sail systems can be a significant contributor to ship radiated noise. It is believed that the creaking, grinding, slipping, galling, clanging, sliding noises produced by raising, lowering and rotating mast systems can be greatly reduced through the use of high damping structural plastics incorporating low observable features. Structural plastics have the potential for adequate combat readiness with quiet, low observable characteristics.

PHASE I: The contractor will: 1) Conduct a review study of structural plastic candidates compatible with the requirement for quiet, low observable capability; 2) Using structural plastics, manufacture test specimens for mechanical property testing, noise testing and radar return testing; 3) Conduct mechanical property tests, noise tests, and radar return tests.

PHASE II: The contractor will: 1) Continue Phase I efforts to determine the best materials for full scale exploitation; 2) Using the best material, the contractor will design, manufacture, and provide to the government, for testing, a developmental Type 8 MOD 3 outer-head housing and upper section of mast and a developmental Integrated Electronic Mast/Above Deck Sensor Unit (IEM/ADSU) housing and upper section of mast and adapter; 3) Using the materials of 2) above, manufacture, test specimens for mechanical property testing, noise testing, and radar return testing; 4) Conduct mechanical property, noise and radar return tests on the materials of 3 above; 5) Conduct RCS tests on the Type 8 MOD 3 outer head housing and upper section of mast and on the IEM/ADSU housing and upper section of mast.

PHASE III: Using the results of Phase I and II, the contractor will: 1) Further define candidate materials for limited production; 2) Conduct analysis and planning in support of limited production of IEM/ADSU and Type 8 MOD 3 units; and 3) Manufacture four (4) each of the production type IEM/ADSU and Type 8 MOD 3 units for contractor and government testing, installation and evaluation.

COMMERCIAL POTENTIAL: The automotive, aircraft and plastic/elastomer industries could benefit from this effort, providing superior cabin and interior environments with reduced ambient noise and longer working lifetimes.

N95-189 TITLE: Development of Manufacturing and Assembly Methods for the Production of Acrylic/Fused Silica, Laminated, Composite, Heated Periscope Head Windows

OBJECTIVE: Develop and provide structurally adequate Naval periscope headwindows which will be compatible with underwater explosion survivability requirements.

DESCRIPTION: The proposed effort to develop and manufacture acrylic/fused silica, laminated composite, heated periscope head windows using electro-conductive coating heating to harden the head/head window region of the periscope, will prevent periscope flooding and thereby increase the periscope underwater explosion resistance and survivability.

PHASE I: The contractor will perform assessment and evaluation studies of approaches for the manufacturing of acrylic/fused silica, laminated, composite, heated periscope head windows using electro-conductive coating heating. Develop and identify the manufacturing and assembly methods suitable for structurally adequate periscope head windows. Perform structural and thermal analysis to support the various alternate approaches. Develop engineer drawings of those approaches which offer the greatest potential for Phase II development. Deliver bi-monthly letter type progress reports and a detailed final technical report covering all work performed in Phase I including analysis, drawings and sketches, study results, conclusions and recommendations.

PHASE II: Develop and provide ten (10) developmental acrylic/fused silica, laminated composite, heated periscope head windows for test and evaluation. Provide complete manufacturing technical report covering all Phase II effort including test procedures, test results, analysis, manufacturing and assembly methods, study results, drawings and sketches, conclusions and recommendations.

PHASE III: Using the results of Phase I and II, the contractor will: 1) further define materials and processes compatible with limited production; 2) conduct analysis and planning in support of limited production; 3) manufacture and provide ten (10) prototype acrylic/fused silica, laminated composite, heated periscope head windows using electro-conductive coating heating for contractor and government testing, installation and evaluation.

COMMERCIAL POTENTIAL: The optical automotive and aircraft industries will benefit from this innovation through very rigid and dimensionally stable large-scale optical materials (to improve chassis and airframe stiffness despite large window are) and processes that are applicable to practical optical problems related to fogging, icing, and visibility in both automotive and aircraft.

N95-190 TITLE: Develop and Produce New Elastomeric/Plastic Foam Materials for Shock Wave Attenuation

OBJECTIVE: Develop materials, formulations, and processes for producing new, unique shock wave attenuating materials which are designed to utilize both shock wave reflection and energy absorption mechanisms.

DESCRIPTION: There is a need for improved shock wave attenuating foam (SWAF) materials to provide increased underwater explosion (UNDEX) survivability of vulnerable, wet components and systems. The proposed effort will extend current SWAF technology by incorporating both shock wave reflection and energy absorbing mechanisms such as to produce SWAF materials with improved attenuation properties leading to decreased volumetric requirements and potentially decreased costs.

PHASE I: Formulate develop, and manufacture SWAF specimens incorporating new concepts and new fiber and matrix materials which offer potential for increased shock wave attenuation through both reflection and energy absorption mechanisms. Compression and sound speed tests will be conducted.

PHASE II: Using the concepts, approaches, processes and materials offering the greatest overall potential for Naval SWAF applications proposed in phase I, focus on (1) formulating and processing for quantity production and quantities of SWAF panels (12" x 12" x 2" and 30" x 30" x 2") as needed for sound speed, compression and UNDEX testing. UNDEX tests will be conducted on those concepts and materials offering the greatest overall potential for Naval SWAF applications.

PHASE III: Using the results of Phase I and II, the contractor will: 1) further define and finalize candidate materials suitable for limited production; 2) conduct analysis and planning in support of limited production of a candidate material which is acceptable for both technical and production viewpoints; and 3) manufacture ten (10) sets of shock wave attenuating foam for contractor and government testing, installation, and evaluation.

COMMERCIAL POTENTIAL: The plastic/elastomer, shock and sound industries will benefit from this innovation.

N95-191 TITLE: Connection of Simulation Based Design (SBD) and Advanced Distributed Simulations (ADS) for Military System Development

OBJECTIVE: To enhance Simulation Based Designs (SBD) by building an executable representation of a numeric model to conform to the protocols for execution in Advanced Distributed Simulations (ADS). The goal is the ability to use SBD output as ADS input and vise-versa.

DESCRIPTION: SBD has been shown to provide cost savings in the development of large military systems through the early detection and resolution of problems that require prototypes or mock-ups to visualize. The key advantages are using information at the earliest possible opportunity to visualize the system, and collection of information from all domains into a coherent system model. For instance, knowledge of the landing characteristics of a given aircraft intended to be housed on a given surface vessel may be used to avoid costly miscalculations in hangar door size or light placement, even if both the aircraft and the surface vessel are still on the "drawing board". Executable computer models of each system can be created to ensure that the dynamics of one do not interfere with the other.

In another area of technology, ADS is being used to provide cost savings in acquisition and enhanced fidelity of experimentation, test and evaluation and training. These simulations are carried out via various distributed networks available allowing the integrated exercise of executable models, databases, prototypes and mock-ups and hardware-in-the-loop (HWIL) without relocating all of the elements involved to one central site or substituting improper or inconsistent modules. In order to execute all of the models as if they were a part of the same system, certain protocols must be embedded within the models which accept, interpret and act upon messages according to the behavior of the system represented. These models must also emit messages which indicate the response of the modeled system to its stimuli.

Models built with SBD are highly integrated with the parts and domains of the system under development, but are rarely compatible with the models used in ADS. That is to say, if they exist, SBD models lack the structure and protocols necessary to respond to messages defined for such simulations. This is unfortunate, since it represents a disconnect of the type that both technologies are hoping to avoid; providing access to design information as soon as it is known in order to evaluate the total design. Reasons include the fact that the SBD model is usually a "work-in-progress", while the ADS model is static; the tools for SBD are not developed with ADS in mind; and certain required characteristics of an ADS model are not necessary in an SBD model (e.g. real-time response).

What is needed is a technique for the automatic translation or enhancement of an existing SBD model or construction of such a model if none exists to conform to protocols for execution in an ADS exercise. This would provide two benefits. First, once a particular design has reached a stable configuration, it would allow developers of other related systems to assess the impact of design decisions made in its development. Second, it would allow the designers to assess the impact of critical changes to the design using the very latest and highest fidelity external data from models or fielded systems.

PHASE I: Development of the technique for the enhancement of SBD models which comply to protocols for ADS. This would include a characterization of SBD model types, an analysis of ADS protocol for each type, and a technique for the conversion of the SBD model to one suitable for ADS usage. Apply the techniques to a simple system design.

PHASE II: Produce a prototype tool which would automate the Phase I techniques. The tool would include the possibility of use and input to the SBD-ADS translation with the intent of responding to the specific needs of the simulation. Demonstrate tool on an example SBD model.

PHASE III: A Phase III effort would produce a commercial quality tool which accepts models of various types and levels of fidelity, which allows the user to tailor the transformation to suit particular needs and which operates efficiently so that the model is produced and can be exercised in such a way that simulation results are enhanced by the SBD changes to the ADS demonstration.

COMMERCIAL POTENTIAL: The computer tool developed to aid in the design, test, and evaluation of military systems can also be used for commercial systems. Examples are computer-embedded systems for transportation communications and air traffic control.

N95-192 TITLE: Develop Mechanical and Environmental Test Procedures for Transmit/Receive (T/R) Modules Procedure

OBJECTIVE: To develop mechanical and environmental test procedures for transmit/receive (T/R)modules.

DESCRIPTION: The use of phased arrays in radar and communications applications improves reliability of the system by removing several high failure rate items from the system. However the phased array itself is made up of numerous elements that must meet reliability requirements. Active arrays are made up of numerous active transmit/receive (T/R) modules, each incorporating amplifiers and antenna elements. Mechanical and environmental test data for T/R modules is required to establish their suitability for active array applications. Mechanical and environmental test procedures will be developed for use as reliability prediction tools.

PHASE I: The contractor shall investigate the design and construction of T/R modules and determine possible failure mechanisms. A test methodology shall be developed for mechanical and environmental testing that will stress the module to simulate actual use with consideration of the identified failure mechanisms. The test methodology shall incorporate optimized tests that will stress the module without undue expense or test complexity The test methods developed shall be documented in procedures.

PHASE II: The contractor shall perform mechanical and environmental testing on a small sample of available T/R modules following the procedures developed during phase I. Improvements to the procedures shall be identified based on test results.

PHASE III: Implement the test procedures across all T/R module developments.

COMMERCIAL POTENTIAL: Optimized environmental and mechanical test procedures will benefit commercial T/R module manufacturers since it will help them improve module reliability by indicating failure mechanisms triggered by environmental and mechanical stresses. Synthetic aperture technology has already been use in nonmilitary applications such as radar terrain mapping, and can expect much wider use in commercial radar when the technology problems are resolved. T/R modules eliminate the need for microwave tubes and wave-guides, and can improve reliability and performance.

N95-193 TITLE: Optimal Active Array Architectures for Communications Applications

OBJECTIVE: Identify and develop active array architectures which provide an optimal combination of characteristics in communications system applications in the areas of: (1) low cost, (2) low bit error rate and array low sidelobe performance, (3) reduced weight and complexity, and (4) graceful degradation.

DESCRIPTION: Solid state elements have the potential for providing lower cost, lighter phased array systems. However, better insight into overall architectures for employing these devices is currently needed. Detailed system engineering studies shall be performed to identify optimal active array architectures. Specific areas to be studies may include the RF distribution system, distribution of taper commands and prime power, air and liquid cooling approaches, the number transmit/receive (T/R) modules to power supply modules and their spatial distribution in the aperture, and periodic operational calibration techniques and their impact on architecture. The impact of emerging technologies, such as photonics, may be investigated to determine how they can best be exploited in terms of the array architecture (e.g. RF distribution and time delay beam steering). This investigation shall screen out architectures which are not feasible and shall develop preliminary performance requirements at the T/R module and subarray level for the most feasible architectures such that experimental architectures can be built and tested at the subarray (or column) level. Additionally, the design architectures or communication system active arrays under development, such as CEC and Iridium, should be reviewed (if possible) to identify areas of potential optimization, particularly those which will reduce cost.

PHASE I: Identify candidate optimal architectures and perform initial top level systems engineering studies to rank the architectures from most feasible to least feasible. Select at least three architectures far a detailed evaluation in Phase II and develop a detailed evaluation plan for phase II.

PHASE II: Perform detailed performance and cost analyses of the candidate optimal architectures selected in phase I. Develop detailed T/R module and subarray requirements for the two most promising candidates and build and test these designs. Develop cost feasibility projections for commercial applications.

PHASE III: Develop a low cost producible design(s) for the optimal architecture(s) based on the evaluation of phase II. Areas to be addressed are component reliability, performance margins, and improvements to manufacturing processes. There are a large number of potential commercial applications in the wireless communications arena, ground stations, VSATs, and point-to-point mobile communications. The potential markets are the broadcast industry (TV, cable, DES, etc.), law enforcement voice/data communications, and the growing mobile cellular, spread spectrum, and satellite personal and voice data communications. Phase III will address a need in one of these commercial areas/markets.

COMMERCIAL POTENTIAL: Active arrays for commercial use that are low in cost will be widely accepted for commercial communications and radar systems. Synthetic aperture technology has already been use in nonmilitary applications such as radar terrain mapping, and can expect much wider use in commercial radar when the technology problems are resolved.

N95-194 TITLE: Develop a Channelized Direction Finder

OBJECTIVE: The objective of the Channelized Direction Finder is to provide key device technology needed for performing precision angle of arrival measurements in wide instantaneous bandwidth environments with simultaneous, copulse, emissions.

DESCRIPTION: The proliferation of high duty cycle radar signals in the radar spectrum results in multiple radar transmissions at the target platform. To accurately assess the threat environment the individual transmissions need be independently measured. Signal parameters are measured using channelization techniques. The Channelized Direction Finder program extends the Channelization function to the measurement of signals' angle of arrival.

PHASE I: The contractor will perform a feasibility analysis, establishing a practical approach for implementing the system processing function and will provide technology developments and demonstrations necessary to this effort, including a 'roadmap' of the feasibility efforts, developments, and demonstrations. The feasibility analysis will consider the range of signal conditions in which the sensor must operate. The constraints on the contractor's approach will be established and the critical development areas in the approach will be defined.

PHASE II: Critical technologies and device developments will be addressed during this phase to show performance progressions necessary in operational equipment. A demonstration of the proposed approach will be provided based upon the feasibility analysis conducted in PHASE I. Both laboratory and shipboard demonstrations will be performed to verify the contractor's approach.

PHASE III: Development of the Channelized Direction Finder model will be implemented for shipboard engineering tests with the ESM-ATD. Antenna and processor interfaces for the ESM-ATD will be provided by the contractor and the contractor will support system integration. Successful development will form the basis for incorporation into IEWS.

COMMERCIAL POTENTIAL: Air Traffic Control, Navigational Aid

REFERENCES:
1. Levitt, H.L., Alexander, E.M., Fine, T.A., TSE, A.Y., Spezio, A.E.; ousto-Optic Precision Direction Finding System; S.P.I.E. Vol. 1958, September 1993.
2. Spezio, A.E., Lee, J., Anderson, G.W.; Acousto-Optics for Systems Applications; Microwave Journal, February, 1985.

N95-195 TITLE: Development of an Automated Logistics Software to Implement Hardware Change Control and Parts Control from Problem/Failure Reports of the Cooperative Engagement Capability (CEC) Program.

OBJECTIVE: Develop a software program using DBase, Foxpro, Excel or similar software that will take information from Problem/ Failure Report Data and automatically revise hardware serialized configuration of the system to the Lowest Replaceable Unit (LRU) and update spare part availability status from 610 test sites.

DESCRIPTION: The Automated Change Control and Parts Control Software Program is envisioned to be a labor saving, cost effective way to provide logistic coordinators and configuration management personnel accurate realtime data on the status of actual configuration of military hardware and the spares available to support these configurations in case of equipment breakdowns.

PHASE I: The contractor shall research existing user software and establish contacts within the organization. The contractor shall determine the appropriate hardware and software tools by performing an initial user study, and following the recommendations of CEC Program contacts. The product of Phase I shall be a report that list the necessary software and hardware, and fully describes the user interface process and intended approach for software development.

PHASE II: Upon successful completion of Phase I, the contractor shall generate the software program and test the program in a simulated user environment. The skill level of users shall be equivalent to test and support personnel skills conducting military
equipment testing.

PHASE III: The contractor shall provide a marketable software program detailing the necessary hardware and software required along with a handbook detailing the user requirements and procedure to fully utilize the program. By providing a generic program, the software can enhance existing systems and reduce the amount of manual key entry in data bases at commercial enterprises. Complimentary information will be revised automatically and simultaneously.

COMMERCIAL POTENTIAL: An inexpensive labor saving and reliable software tool that automatically revises data for use by logistic and product support personnel. This software will appeal to virtually any commercial enterprise involved in maintaining records of special equipment such as a fleet of cars or records of part replacement on products sold to customers and maintained by the product manufacturer/distributor tie., Heating Ventilation Air Conditioning (HVAC) Systems or Industrial Equipment. This off the shelf software should be especially useful to small businesses that cannot afford the large capital expenditure for configuration and inventory control.

N95-196 TITLE: Develop a Lightweight Electronic Equipment Enclosure

OBJECTIVE: Develop a lightweight, low cost, electronics equipment enclosure suitable for use in a military shipboard environment.

DESCRIPTION: The Navy is currently imposing a weight limit on the Cooperative Engagement (CEC) System. Since a significant portion of the electronics is purchased, and the power control hardware of necessity contains a great deal of copper, the next likely candidate for weight reduction is the enclosure. This is especially true given that standard enclosures now in use are heavy and expensive to produce. A lightweight enclosure built to fully hardened (non-nuclear) requirements for ship internal electronics equipment is desired. The CEC System requires that this enclosure be configured to house and remove heat from up to 186 6” X 9” “double eurocard” convection cooled circuit cards, their associated power supplies and conditioners, and electronics controls.

Such an enclosure could provide a model for future enclosures in Navy systems as electronics continue to shrink and new ships are built smaller and lighter.

PHASE I: Develop initial drawings of the enclosure. Provide a report on the development of the enclosure including such considerations as alternate materials, possibly composites. Address concerns of EMI/EMC shielding, shock, and vibration compatible with a shipboard military environment.

PHASE II: Develop and deliver a Level III drawing package suitable for production of the enclosure.

PHASE III: Manufacture full scale prototypes for environmental, shock, vibration, EMI, and other tests. Participate in testing and additional design efforts in order to produce a useable final design.

COMMERCIAL POTENTIAL: Technology from the development of lightweight, low cost, producible enclosures may be transferrable to the aviation and automotive industries. Lightweight is a highly desirable feature of equipment in the transportation sector where the economics of fuel consumption are paramount. As more sophisticated electronics makes its way into commercial transportation there will be a need for lightweight, low cost environmentally rugged methods to package those systems.

REFERENCES:
1. MIL-STD 2036

N95-197 TITLE: Chemistry of Self Propagating High Temperature Synthesis (SHS) Particle Clouds in Air

OBJECTIVE: Develop dispersion and ignition of SHS particle clouds in air and measure reaction rates and energy release.

DESCRIPTION: Technology has been developed to prepare SHS particles with metal to metal or metal to carbon systems. Of particular interest to the Navy is the dispersion of these particles in air to form clouds with subsequent chemical reactions.

PHASE I: Research should focus on proving the ability to inject and form SHS particle clouds in the air. The effort should demonstrate an understanding of ignition conditions, propagation conditions, and be able to measure the chemical reaction rates.

PHASE II: Develop those techniques formulated in Phase I to disperse and ignite the SHS particles with measurement of chemical reaction rates. Experimental conditions such as dispersion conditions type of particles (metal/metal or metal/carbon systems) particle size, morphology, compaction of original bed (porosity) and enhancing ingredients should be systematically studied and related to chemical reaction rates.

PHASE III: Military applications from this technology will transition into the Projectile Technology Program.

COMMERCIAL POTENTIAL: Industries that need to understand accidents involving explosions of particles in the air (i.e. coal mines, flour mills, metal powder factories) would benefit from this technology. The U. S. Bureau of Mines, Pittsburgh Research Center Fires and Explosions Office has expressed interest in assisting Phase II awardees in preparing the process for further development in Phase III.

REFERENCES:
1. J. E. Gatica and V. Hiavacek, "Laboratory for Ceramic and Reaction Engineering", Ceramic Bulletin, Vol 69, No. 8, 1990

N95-198 TITLE: Prompt Formation of Metallic Vapor Clouds

OBJECTIVE: Demonstrate ability to simultaneously generate metal vapor clouds from Self Propagating High Temperature Synthesis (SHS) reactor beds.

DESCRIPTION: A combustion synthesis utilizing metal/metal and metal/carbon reactor beds are well documented in the open literature. Reaction rates are proportional to particle size, morphology, compaction (porosity), and rate of bulk heating. The proposed new technology would combine SHS reactor bed technology with the ability to simultaneously vaporize metal from the large heat fluxes.

PHASE I: Demonstrate feasibility to prepare SHS reactor beds containing metals to be vaporized. Determine the basic combustion characteristics, mass balance, metal vapor, and heat evolved.

PHASE II: Develop the experimental SHS techniques for optimization of metal cloud formation and cloud modeling. Demonstrate the understanding of the process for sample preparation and physical property characterization.

Expand characterization of composition preparation and combustion conditions. Develop methods of prompt initiation of reactor beds and formation of metal vapor. Demonstrate the relative importance and applications of metal vapor oxidation versus non-oxidation deposition (plating). Deliver prototype reactor bed that simultaneously develop metal vapor clouds for military application.

PHASE III: Military applications that would benefit from this technology are reactor linings, heat shields, and numerous metallurgical products. This technology should transition into the Projectile Technology Program.

COMMERCIAL POTENTIAL: Industries that need new reaction engineered materials for high temperature and/or erosive environments such as reactor linings, heat shields and new metallurgical applications can benefit from this technology.

REFERENCES:
1. J. E. Gatica and V. Hiavacek, "Laboratory for Ceramic and Reaction Engineering", Ceramic Bulletin, Vol 69, No. 8, 1990; "Aluminum Vapor Release in the Atmosphere", RAD-TR-76-221, 1976. ADA028060

N95-199 TITLE: Data Compression Techniques on Microwave Link

OBJECTIVE: Explore possible data compression techniques to shorten transmission time, reduce transmission power levels, or improve data throughput of microwave spread spectrum jam resistant communications links.

DESCRIPTION: The Navy is developing a communications network to allow ships to share air defense radar and fire control data among a battle group. The program is termed the Cooperative Engagement Capability (CEC). One of the key technology areas of the program is the communications link between ships. This is done using jam resistant encrypted communications on microwave (Cband) links. Current problems in these links are: the power required to meet operational specifications (and hence the size and weight of the CEC system) is higher than desired and the data throughput of the links is not as high as desired.

PHASE I: The contractor shall research possible data compression techniques that are compatible with the encryption scheme employed and present a tradeoff analysis of the techniques (either software, hardware or a combination of the two).

PHASE II: Upon acceptable results of phase I, the contractor shall develop a test system for application on a CEC unit during operational testing.

PHASE III: Development of a component or module along with requisite software for production CEC systems which can be transitioned to very high data rate transmission for use in cellular, satellite, or broadcast communications.

COMMERCIAL POTENTIAL: The data compression technique developed will also be useful for other microwave link applications, such as landbased communication repeaters, or satellite communications. Data compression techniques for microwave communication have direct application to commercial communications technology, particularly in the field of satellite communication. This technology would allow greater capacity in present and future communications satellites.

N95-200 TITLE: Development of Rapid Prototyping of Application Specific Signal Processors (RASSP) Program Interface for the Cooperative Engagement Capability (CEC) Program

OBJECTIVE: Develop an interface to the RASSP program toolset to allow the CEC program development team access designed development tools in support of the processor designs used by the CEC program.

DESCRIPTION: The RASSP program is envisioned as being a large networked development environment for electronic products. Current activity has just begun to establish the tools that will be made available inside the RASSP design environment (RDE). The RDE will offer the user the ability to access and use a suite of design, development, test and simulation tools to rapidly design and debug a new electronic product without the need to purchase a lot of expensive computer-based design tools. It is the development of an interface to the RDE that is the objective of this SBIR topic.

PHASE I: The contractor shall research the developments of the RASSP RDE and establish contacts within the organization. The contractor shall select the appropriate hardware and software tools by performing an initial concept study, and following there commendations of RASSP RDE contacts. The product of phase I shall be a report that lists the necessary software and hardware, and fully describes the user interface process.

PHASE II: Upon successful completion of phase I, the contractor shall establish a RASSP RDE interface system, and perform initial design of a CEC product (to be determined prior to award of phase II) using the RDE.

PHASE III: The contractor shall develop a marketable interface product consisting of the necessary hardware and software, along with a handbook detailing the user requirements and procedures to fully utilize the RDE.

COMMERCIAL POTENTIAL: An inexpensive alternative to expensive tools for the design of complex electronic components, modules, and systems will appeal to virtually any commercial enterprise, and especially small business that cannot afford the large capital expenditure of a dedicated design tool suite. Also the standardization of the design interface will save redundant efforts on future designs. Application specific signal processors have direct application to commercial communications and radar technology.

N95-201 TITLE: Shared Aperture Concepts for Point-to-Point Communications

OBJECTIVE: Maximize the utilization of ship and airborne equipment by sharing aperture, transmitter, and processors between communications, radar, and possibly EW tasks.

DESCRIPTION: The Navy is seeking methods to achieve reductions in the overall size, weight, and cost of equipments on combatant ship and aircraft by sharing common subsystems among different functions. For example, on AEGIS ships, three of four arrays are idle at any given time. The idle arrays could be used to provide enhanced communications with other ships or aircraft using pencil beams via a secure wideband data link. This will replace other equipment performing a similar function. These, and other shared aperture techniques using active array technology, promise to reduce overall system costs compared to the use of separate equipment.

PHASE I: Determine the requirements for secure fleet communications and examine concepts for meeting these requirements using shared aperture/transmission equipment. Examine both near-term concepts using existing arrays and equipment, and far-term concepts using active array approaches. Perform a preliminary assessment and recommend candidate concepts for detailed analysis in phase II.

PHASE II: Perform a detailed analysis on the concepts identified in Phase I. Assess performance and identify potential cost savings and compromises resulting from the shared aperture concept. Prepare plan for development and demonstration of promising approaches. Develop a performance simulation and techniques for configuring and reconfiguring the sensor and communication modes in real time. Develop, demonstrate, and evaluate a scaled breadboard system that can perform radar, communications, and possibly electronic warfare functions.

PHASE III: Develop the system for use in current Navy radar or communications systems. Proceed with the commercial introduction of the system developed under phase II into the commercial airlines and air freight markets since these are large volume markets which can further reduce costs through economies of scale.

COMMERCIAL POTENTIAL: Similar gains in shared equipment will be realized by commercial communications and radar systems aboard merchant vessels. Commercial ground based and mobile communication systems may also benefit by using the equipment sharing approaches developed by this study.

N95-202 TITLE: Integrated Tester Software Diagnostics

OBJECTIVE: To improve upon currently available automated diagnostic totals by developing a total suite consisting of next generation diagnostic algorithms and a tester simulation environment.

DESCRIPTION: The Navy currently uses CASS (Consolidated Automated Support System) board testers to perform diagnostic tests on complex electronic modules. The diagnostic test development is a time consuming process involving several CASS tools and use of the tester itself. Once the diagnostic test is developed it must be tested by manually inserting faults on a device under test (DUT) and verifying that the diagnostic test finds the expected fault. In order to validate a diagnostic test program with some efficiency, only a small fraction of possible faults are actually inserted and verified for detection by the diagnostic test program. A new tool that can simulate a tester in software, and be integrated in the test development environment, will save the expense of using the tester for diagnostic program validation and lengthy software troubleshooting. This tool will also allow far more faults to be verified as detectable without tying up valuable tester resources.

PHASE I: The contractor shall research the requirements for simulation of the tester in software, and develop a fundamental approach for the creation of an integrated diagnostic tool that allows for fault verification in an integrated test software environment. The contractor shall also investigate development of improved diagnostic algorithms that may shorten the development time or improve the performance of fault diagnostic programs.

PHASE II: Upon the successful completion of phase I, the contractor shall develop the CASS simulation environment and integrate this with improved diagnostic development tools identified during phase I. The program shall be tested using an actual module test development identified by the government at the start of phase II.

PHASE III: The tester simulation teals and environment may be developed as a fully documented and supported toolset for use on CASS test development systems. This toolset would be made available to DOD and commercial industries to increase efficiency in all government and commercial test program set development. The

Cooperative Engagement Capability (CEC) program will use this toolset in the development of a commercial off-the-shelf (COTS) circuit card assembly.

COMMERCIAL POTENTIAL: The same automated diagnostic tool suite used by the Navy will be used by many commercial companies in the electronics industry. The new methodology could be applied to COTS circuit card assemblies in particular, and be available for all test program set developments in the future for both commercial and DOD industries.

N95-203 TITLE: Improve Thermal Efficiency of Microwave Transmit/Receive Modules

OBJECTIVE: Improve the thermal efficiency of microwave transmit/receive (T/R) modules by applying improved materials or altering the manufacturing process.

DESCRIPTION: T/R modules are solid state devices incorporating amplifiers, phase shifters, and detector/receiver circuits in a single hermetic package for use in radio communications. Current technology of T/R modules yields an operating efficiency of roughly 30% causing the modules to run extremely hot, especially when designed for significant transmit power. Since this power loss is usually concentrated in small areas in the T/R modules, there is significant localized heat buildup that degrades the services. Cooling techniques that dissipate this heat buildup must be improved to allow for more powerful T/R modules.

PHASE I: The contractor shall investigate the various available cooling techniques applied in high power electronic devices and research the possible application of these techniques to the production of T/R modules. The contractor shall produce a report summarizing tradeoffs in available cooling techniques and suggest the best methods for application in T/R modules. Tradeoffs shall include cost, producibility and effectiveness.

PHASE II: The contractor shall develop a demonstration prototype T/R module using the improvement. The demonstration shall be tested for operating efficiency and thermal performance in contrast to the existing T/R module design. Results shall be summarized in a report.

PHASE III: The improved thermal T/R module may be developed for production and integrated in existing communications systems.

COMMERCIAL POTENTIAL: Commercial communications systems will benefit from improved thermal performance of T/R modules since this will allow for application in areas previously possible only for other technologies. Improvement in the thermal efficiency of T/R modules will allow greater packaging efficiency, reducing the cost of materials and assembly making them more attractive to commercial communications markets. Microwave T/R modules are critical to active aperture array technology. Synthetic aperture technology has already been use in nonmilitary applications such as radar terrain mapping, and can expect much wider use in commercial radar when the technology problems are resolved. T/R modules eliminate the need for microwave tubes and waveguides and can improve reliability and performance.

N95-204 TITLE: Develop Robust Nonlinear Control Technology

OBJECTIVE: Develop robust nonlinear control techniques to improve robotic control systems for application to future highly agile missile interceptors.

DESCRIPTION: The Navy needs an advanced controller for future ship defense missiles which will emphasize nonlinear techniques to control missile agility and responsiveness. The engagement of rapidly maneuvering anti-ship missiles cause the need for defensive missile operation in widely varying altitudes which are characterized by high angles of attack, and nonlinear control performance due to saturation and hystoresis effects. Nonlinear operation of electric motor actuators, hydraulic actuators, and hot and cold gas driven control actuators is expected. Robust, nonlinear design methods shall be developed for a very agile, fully coupled, multi-channel missile control system. The primary goals will be to minimize cross coupling effects and to enhance tolerance to aerodynamic uncertainties, environmental errors and unmodeled flexible mode dynamics.

The design methods should be modeled into algorithms which can be demonstrated by computer simulation. Emphasis will be placed on reducing control complexity and the ability to execute control functions for real time implementation in a missile flight computer.

PHASE I: Design and develop and report control system techniques and demonstrate their effectiveness in a computer simulation.

PHASE II: Design and produce an optimum controller for Navy targets and Navy-given flight characteristics. Build and deliver a prototype controller and demonstrate it in Navy flight tests.

PHASE III: Transition the prototype controller to support the development of a Navy highly agile interceptor missile.

COMMERCIAL POTENTIAL: Commercial uses include robotics, manufacturing, aircraft and future automobile breaking and drive train applications. Nonlinear control techniques will allow the use of smaller motors and actuators in many commercial control devices.

N95-205 TITLE: Develop a Left/Right Passive Bearing Ambiguity Resolution Sensor (BARS) for Torpedo Defense

OBJECTIVE: Develop and provide a means of instantaneous bearing ambiguity resolution for threat torpedoes at tactically significant ranges through modification of existing towed systems aboard U.S. Navy Surface Ships.

DESCRIPTION: An affordable solution to the left/right ambiguity problem is to modify existing surface ship towed equipment with an acoustic aperture designed specifically to instantaneously resolve bearing ambiguity in frequency ranges consistent with threat torpedo radiated noise. Directional sensors should be integrated into existing towed equipment. The tow cable may be redesigned to accommodate the increased data requirements. Sea test will be conducted, left/right ambiguity and detection capabilities will be determined.

PHASE I: Analytical proof of concept will be provided which models the expected performance of the bearing ambiguity resolution sensor.

PHASE II: The technology will be demonstrated at sea after modification of an existing U.S. Navy towed system.

PHASE III: The technology will transition to the fleet by incorporation of an ECP to an existing system.

COMMERCIAL POTENTIAL: A BARS sensor can provide a low cost, time saving method of locating and monitoring populations of aquatic life, such as fish or shrimp. Such a sensor could also be used for navigation and vessel identification in heavy shipping areas or in operations such as drug interdiction. Locating other sound producing sources, such as underwater fissures, provides another potential application.

N95-206 TITLE: Develop and Produce High Precision Sensors for Under-Ice Submarine Operations and Unmanned Undersea Vehicle (UUV) Missions

OBJECTIVE: To develop and provide precision gravity and other passive sensors to meet military and scientific needs. Identified Military needs include (1) precision navigation for under-ice submarine operations, and (2) navigation, positioning, and localization for UUV missions. Specific scientific needs include (1) oil exploration and (2) precious metals and minerals (specifically diamond) exploration (3) studying the earth's topography and (4) developing more accurate atlases. In spite of the high potential pyoff, the industrial sector has not made a significant investment in development of gravity or other precision sensors because of the high technological risk, and have relied heavily on Military development efforts, but quickly exploit new technology when it is proven.

DESCRIPTION: Development of a navigation system that does not rely on radio-frequency (RF) energy and will be capable of supplying submarines with own-ship under-ice geographical fix information. Gravity sensors, as one example, provide two key features for submarines and UUVs: (1) They can determine the gravity deflection caused by a certain region to assist in reducing velocity error growth that occurs in inertial navigation systems, and (2) They can sense gravity fields in a region and match that to a priori maps to perform navigation, positioning and localization. Gravity sensors will also provide a necessary component for an on-board map creating ability. The gravity system is completely passive and can be utilized during all modes of operation. Other innovative solutions are also solicited. The challenge is to develop a high precision sensor that can be effectively utilized by submarines and/or UUVs.

PHASE I: Design and develop a three axis gravity sensor with a very high precision sensitivity rating for either or both platforms.

PHASE II: Fabricate and perform an in-water test with a fully integrated gravity/inertial navigation system.

PHASE III: Integration of fully integrated gravity/inertial navigation system into submarine or UUV.

COMMERCIAL POTENTIAL: The development of this system should have a direct application to the safe navigation of arctic and other waters by commercial ships including tankers and fishing vessels. Natural Resource exploration, which includes oil and precious metals, depends on high sensitivity gravity measurement. Also, air, land, and undersea mapping requires a high precision gravity sensor to accurately determine topography.

N95-207 TITLE: Develop and Produce High Resolution Image Processing with a MidFrequency Active Sonar

OBJECTIVE: The objective is the development and application of commercially available sidescan and sonar synthetic aperture technology for the Navy's surface ship midfrequency, hull mounted active sonar to provide a capability to do high resolution imaging of submarines and small objects on the ocean bottom in shallow water.

DESCRIPTION: Navy midfrequency sonar was originally designed to be a deep water submarine detection, classification, and localization system. Such sonar is now also required to operate in shallow waters with specific emphases on submarines and small object avoidance. To fully achieve these goals requires increased azimuthal resolution. Such resolution has been demonstrated at higher frequencies by commercially available sidescan sonar and synthetic aperture technology. It may be more efficient and cost effective to adapt this commercial technology to the Navy needs than to redesign existing sonar. The innovation needed is to modify the commercial technology to operate at the lower frequencies and longer ranges associated with Navy tactical sonars.

PHASE I: Verify the applicability of Navy midfrequency sonar as a shortrange imaging sonar, identify relevant existing sonar imaging techniques such as sidescan sonar and synthetic aperture imaging, and determine the feasibility of using an existing hull mounted active sonar source over its entire transmit band in concert with a midfrequency line array receiver to image shallow water ocean bottom and midwater column objects at short ranges. Waveform(s), transmission parameters, and processing algorithms will be defined. A plan for follow-on at sea data collection, algorithm development and performance demonstration will be generated.

PHASE II: Implement system and conduct performance demonstration sea trials. Implement required transmit waveform generation and processing and display algorithms for insertion into a midfrequency active adjunct processor or equivalent commercial platform. Conduct sea trials. Analyze performance of system and write final report with recommendations for fleet transition.

PHASE III: Develop an Engineering Change Proposal for a high resolution imaging adjunct processor for a Navy midfrequency sonar.

COMMERCIAL POTENTIAL: A successfully modified Navy sonar would be suitable for applications such as searching broad areas for underwater hazardous waste sites.

REFERENCES:

1. E.T. Sullivan, W.M. Carey, and S. Stergiopoulos, Eds., "Special Issue on Acoustic Synthetic Aperture Processing", IEEE Journal of Oceanic Engineering, vol. OE-17, Jan 1992

2. W.K. Stewart, M. Jiang, and Martin Marra, "A Neural Network Approach to Classification of Sidescan Sonar Imagery from a Midocean Ridge Area", IEEE Journal of Oceanic Engineering, vol. OE-19, pp. 214-224, April 1994

3. P.N. Denbigh, "Signal Processing Strategies for a Bathymetric Sidescan Sonar", IEEE Journal of Oceanic Engineering, vol. OE-19, No. 3, pp. 382-390, July 1994

N95-208 TITLE: Develop and Produce a SSTD Launch Canister

OBJECTIVE: Deign, develop and demonstrate the technology for a conceptual modular, low cost, quick response launcher for Anti Submarine Warfare (ASW) and Countermeasures requiring spin on automotive air bag technology. This launcher would require minimal maintenance and produce no environmentally hazardous byproducts.

DESCRIPTION: Conduct a proof of concept demonstration for a modular gas generator launch system for Surface Ship Torpedo Defense (SSTD) and other over the side launched weapons and countermeasures. The gas generator is to be a direct spin on application of existing and developing automotive passive restraint technology. It benefits the launcher design by permitting a low cost, low maintenance system that produces no environmentally hazardous byproducts. It will also permit SSTD capability to be applied to ship classes that do not have and will not require torpedo personnel as part of the standard crew, such as amphibious assault craft or high value supply ships. This technology has further potential application to the launch of submarine countermeasures, where environmental hazards are of current concern.

PHASE I: Proof of concept analysis will include the marrying of gas generator mathematical models with Navy launch models and conclude with a power requirement study including identification of required modifications to existing commercially used automotive hardware or possibly the use of multiple units through a control system.

PHASE II: The technology will be demonstrated by utilizing a single commercially available off the shelf gas generator to conduct a scale model launch of an SSTD.

PHASE III: Scale up to production baseline prototype.

COMMERCIAL POTENTIAL: The Navy has a high interest in this technology. The gas generator launch system would provide a low cost/low maintenance alternative to existing hardware. A Navy Program office has expressed a willingness to support and transition any efforts in this area, should the technology prove feasible. Civilian potential for the technology includes: optimization of gas generators formore reliable automotive air bags or similar devices; launching a variety of devices, for example distress beacons, recreational gliders, nets for fishing, crowd control, or wild animal capture.

REFERENCES:
1. Mechanical Engineering Magazine, January 1994, "Automotive Safety is in the Bag", Steven Ashley (Associate Editor), pp. 1723.

N95-209 TITLE: Develop New Towed Array Technology

OBJECTIVE: Develop new technology for improvements and enhancement of towed array systems.

DESCRIPTION: Innovative approaches for the design, development and deployment of towed array systems are required in response to changing operational requirements. Towed array technologies are being sought which emphasize commonality with application to both surface and submarine platforms. Requirements for enhancement to towed array systems include development of a means of controlling the depth of a towed array to make it tow above and below submarine depth and to allow towing in shallow water; development of miniature sensors for use in towed arrays; towed array receiver design; signal processor enhancements; and mechanical aspects including fill fluids, hose materials and handling & stowage. The types of cables used to carry towed array electrical signals include: multi-filament; optical fiber cables; hybrid copper; coaxial cables; and multi-strand copper cables. Sensor technologies include: acoustic, magnetic, electric field, navigation, depth, tension, and temperature. Desirable characteristics of sensors include: small size (<1 cm diameter), high sensitivity, high dynamic range (>100 dB), and high bandwidth (>10,000 Hz). Signal processing techniques include: programmable beamforming, frequency spectral analysis, cross correlation, spatial and temporal filtering, replica correlation, amplitude shading, automatic gain control and noise averaging. Fill fluids must provide excellent insulation, be compatible with other materials, have a lower specific gravity than water, be non-flammable and non-toxic. Array handling and stowage systems must provide a reliable means to deploy, retrieve, and stow towed arrays with minimum impact to ship operations, requiring minimal manual labor and preventing damage to sensitive array components. Affordability is a significant issue in towed array design.

Designs should consider the application of previously designed and developed commercial technology and Navy technology to towed array systems.

PHASE I: Develop sufficient data to demonstrate the feasibility of the proposed design. Provide a preliminary design for prototype system/subsystem.

PHASE II: Fabrication and demonstration of prototype system/subsystem.

PHASE III: Products and technologies of this SBIR will be evaluated for applicability to towed array programs.

COMMERCIAL POTENTIAL: Commercial potential for technology developed under this SBIR is dependent on the technology developed and includes: oil exploration, underwater inspection services, process control, and electrical power monitoring and control.

N95-210 TITLE:Develop and Demonstrate Active Sonar Target Motion Analysis

OBJECTIVE: To develop and demonstrate recent Navy techniques for Target Motion Analysis.

DESCRIPTION: The Navy has recently identified several TMA enhancements which offer significant improvement in solution quality and weapon placement accuracy. These techniques include Doppler enhancement, acoustic data sensor weighting by SNR, variable averaging periods, overlapping averaging periods, assigning solution qualities and independent parameter verifications. Continued development, intelligent application and integration of these techniques will be the focus of this work.

PHASE I: Analyze and extend and develop the available techniques for Sonar Target Motion. Implement techniques and run simulated TMA scenarios to establish estimated solution quality enhancements. Investigate and test new TMA techniques in addition to the available techniques.

PHASE II: Plan, simulate, generate and evaluate a comprehensive TMA prototype software package. Run a formal demonstration against existing Fleet TMA programs to establish the level of solution quality enhancements and any areas needing further improvement.

PHASE III: Perform a full TMA demonstration will be performed on a Navy ship during a sea test or other Navy operation. The crew of the test ship will be trained with the new crew training package and the crew will participate in the demonstration.

COMMERCIAL POTENTIAL: This work will have excellent commercial application. Areas such as port authority harbor management, air and ground airport tracking, automatic collision avoidance for merchant shipping and fish school motion analysis for commercial fishing will be able to use many components fo this development effort.

N95-211 TITLE:Develop a Surface Ship Acoustic Countermeasure (CM)

OBJECTIVE: Develop and provide a semi-autonomous water craft deployable from U.S. Navy surface ships including an integrated payload of Acoustic Countermeasures (ACM) to distract, deceive or otherwise defeat acoustic homing torpedoes.

DESCRIPTION: Surface Ship acoustic countermeasures other than towed acoustic countermeasures have been borrowed from submarine developments. The Surface Ship does not have the same size constraints as does the Submarine. Therefore, it is possible to use a small water craft in conjunction with existing amplifiers, communication, navigation, and underwater sound projector hardware to create a low cost and high performance acoustic countermeasure. The countermeasure should be able to tow its transducer at approximately 15 Knots and through the use of GPS navigation, proceed to points directed from shipboard systems. A digital communication link from the ship would supply the countermeasure with navigational instructions and transmit waveforms. The CM should be small enough to be dropped from the ship automatically and easily brought back onboard for refueling or recharging.

PHASE I: Develop and complete initial design to a level expected at Critical Design Review (CDR).

PHASE II: The design will be completed and the prototype built. The prototype will be tested at sea by the Navy.

PHASE III: The technology will be transistioned to the fleet by incorporation of an ECP to an existing system.

COMMERCIAL POTENTIAL: The small autonomous surface craft and its related control system could be useful in many commercial areas including rapid underwater contour mapping and underwater salvage.

N95-212 TITLE: Develop Mission Adaptable Control Strategies for a Resilient Unmanned Undersea Vehicle (UUV) Control System

OBJECTIVE: Develop and demonstrate a unified and mission adaptable control strategy for a tactical UUV that could be field reconfigured for a range of tactical missions.

DESCRIPTION: An innovative and cost effective solution to provide a high level intelligent controller for tactical UUVs is sought. This control system must be adaptable to tactical sensor changes, a wide range of mission profiles, operational environments and mission priorities. The control system must provide the resiliency necessary to maintain its own integrity in event of computational hardware or software degradation or failure while continuing to accomplish primary mission objectives even under adverse environmental conditions and UUV subsystem/component degradation or failure. While the Navy and its contractors have evaluated many control system architecture and control techniques, including closed equation algorithmic, neural networks, fuzzy logic algorithms and knowledge or rule-based decision trees, no single approach has proved to be satisfactory even for relatively simple missions and vehicles. A more satisfactory solution may be found by blending control techniques in a unified control concept that can be varied from mission to mission to provide adaptive and resilient control of the vehicle and its subsystems. It is mandatory that any of the control/decision processes be executable on a single hardware configuration using commercial-off-the-shelf hardware and standard, well-supported, operating system and application software.

PHASE I: Develop and analytically demonstrate the feasibility of the concept.

PHASE II: Demonstrate adaptability and resiliency via laboratory simulation.

PHASE III: Produce and integrate the control system into a Navy UUV water validation.

COMMERCIAL POTENTIAL: The Navy has a strong interest in using UUV technology for mine warfare, tactical oceanography, ASW surveillance and intelligence gathering missions. Commercial applications for long endurance UUVs include the areas of pipeline inspection, underwater structure damage assessment, pollution detection/mapping, resource exploration/mining and a host of other underwater missions not suitable for ROVs (tethered UUVs) or manned submersibles.

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND

N95-213 TITLE: Shipboard Production of Intravenous Fluids

OBJECTIVE: A preproduction prototype of a device capable of meeting Food and Drug Administration (FDA) licensing criteria, that uses shipboard potable water and electrical power to produce properly labelled and filled bags of United States Pharmacopeia(USP) quality intravenous fluids.

DESCRIPTION: There is an urgent need to increase the immediate availability of intravenous solutions aboard ships and to reduce strategic transportation requirements to maintain resupply of these fluids. There is currently no onsite production capability, and no commercially available device exists to meet the need. The system must produce USP quality fluids for injection using U.S. Navy shipboard potable water as the input source. Minimal output should be 36 one liter bags/hour, with an ideal rate of 46 one liter bags/hour. Software and hardware should be compatible with a sterile means to add concentrates to generate (a) isotonic sodium chloride USP (0.9%) in one liter bags, (b) lactated ringer's USP for injection in one liter and half liter bags, (c) sterile water for injection USP in one liter bags, and (d) sodium chloridedextrose solution for deglycerolization of thawed previously frozen red blood cells in three liter bags. The system must make a label meeting FDA standards for each bag of fluid produced. Concentrates must be packaged in FDA approved bags which have a shelf life of at least two years (optimally 3 years) and special identification markings to prevent accidental use during patient care. Bags must be packaged to enable a shelf life of 6 months at a temperature range of +1 Cx to +50 Cx. The system must have a builtin quality control system to monitor and control system integrity throughout the production cycle. The equipment must operate from 110 q 15% volt alternating current 60 Hertz q 2 hertz, with a power requirement of 10 kilowatts or less. The system must meet USN requirements for shipboard space and weight limitations, for electrical safety aboard ships, and function equally well during conditions of moderate vibration, roll, pitch and yaw as when used on a stable platform. Minimal mean time between operational mission failures should be 125 hours (objective = 250 hours),minimal operational availability should be 80% (objective =89%), and mean time to repair should be s 2 hours (objective = s 1.2 hours). Device design should enable local repair with spareparts, consistent with the isolated operational environment. The system should be designed to be operated by one individual with a skill level commensurate with that of a pharmacy technician.

PHASE I: Deliver document which includes (a) detailed analysis of alternate engineering solutions, justifying the selection of the preferred strategy for a prototype device, (b) detailed plans for implementing the selected strategy, including time course for accomplishment, scheme to address critical pathway decisions (including FDA licensing issues), and (c) cost to deliver an engineering prototype device.

PHASE II: Fabricate and deliver an engineering prototype device that meets required specifications

PHASE III: Accomplish test and evaluation of the engineering prototype, pre-market approval discussions with the FDA, and make the required modifications that result in the delivery of a preproduction prototype device.

COMMERCIAL POTENTIAL: This device is likely to have wide commercial application in the medical treatment infrastructure in remote locations of developed countries, and in third world and developing countries with limited transportation capability. The weight and volume of bag sets and concentrates is only a small fraction of the weight and volume of the equivalent number of full bags of solutions ready for infusion. The device will also be valuable in mass casualty scenarios involving trauma (e.g. earthquake relief) or infectious disease (e.g. epidemic diarrhea).

REFERENCES:
1. U.S. Army Medical Materiel Development Activity "Resuscitative Fluids Production and Reconstitution System (ST) Milestone IIIa In-Process Review" of December 1993.

N95-214 TITLE: Portable Rapid Tests for Diagnosis of Campylobacter Enteritis and Shigella Dysentery in Operational Ship and/or Field Environments

OBJECTIVE: Development of portable, rapid diagnostic tests for the field and shipboard detection of enteropathogenic Campylobacter and Shigella in fecal specimens.

DESCRIPTION: Acute infectious diarrheal diseases comprise the single greatest medical threat to Navy and Marine Corps personnel serving overseas. Numerous bacterial, viral and parasitic agents are known to cause periodic diarrhea outbreaks, but enterotoxigenic Escherichia coli, enteropathogenic Campylobacter and Shigella bacteria have been most frequently recovered from deployed forces experiencing acute episodes of diarrhea or dysentery. Although all of these pathogens have missionabortive potential, illnesses caused by Campylobacter or Shigella are the most severe. Both pathogens invade intestinal tissues, causing fever and bloody diarrhea. In field situations, laboratory diagnosis is usually not possible because the necessary materials and equipment are generally not transportable, and because performance of conventional tests require a high degree of specialized skill. Clinically, these agents cause disease which is easily confused with other febrile illnesses, such as malaria and dengue fever. Without an accurate laboratory diagnosis, treatment of severe cases can be complicated because the genera differ significantly in antibiotic susceptibility profiles. A rapid and relatively simple diagnostic assay that identify these two invasive bacteria in stool samples would be of immense clinical and operational value, minimizing the impact of enteric illness on combat readiness by facilitating early and appropriate treatment.

PHASE I: Develop prototype tests based on different antigen detection systems. Emphasis should be placed on the development of diagnostic reagents for the detection of clinically relevant antigensthat will be highly specific for the bacteria of interest, yet have the ability to distinguish the most pathogenic
phenotypes within each group. Tests will be formatted for minimal specimen preparation and equipment/ electrical support.

PHASE II: Refine and optimize assay conditions and reagents, evaluating both polyclonal and monoclonal assay systems. Further test candidate assays in animal models of disease. Based on animal modeling results, select the most sensitive and specific test formats for reformatting into kits and followon clinical and field testing.

PHASE III: Evaluate prototype kits in field and shipboard environments. Select optimum assay system for transitioning to advanced development.

COMMERCIAL POTENTIAL: In the U.S. alone, Campylobacter is responsible for 2.5 million cases of diarrhea annually. Globally, the organisms cause disease in at least 400 million persons per year and they are the second most common cause of travellers' diarrhea among international travelers. Shigella is a leading cause of childhood mortality in the developing world, but is also responsible for large numbers of outbreaks among persons of all ages in the U.S. and Europe. The development of a simple and rapid test for the early diagnosis of these infections would be of significant commercial value, as well as a major public health benefit, serving to reduce childhood mortality worldwide and lessening the economic impact of severe adult diarrhea.

REFERENCES:

1. Taylor, D.N. Campylobacter infections in developing countries. In: Campylobacter jejuni: Current Status and Future Trends (Eds. Nachamkin, I., Blaser, M.J. and Tompkins, L.S.) Amer. Soc. for Microbiol., Washington, D.C. 1992, pp 2030. ADA254386
2. Haberberger, R.L. and Walker, R.I. Prospects and problems for development of a vaccine against diarrhea caused by Campylobacter. Vaccine Res. 1994, 3, 1522 ADA279218
3. Keusch, G.T. and Bennish, M.L. Shigellosis: Recent progress, persisting problems and research issues. Pediatr. Infect. Dis. J. 1989, 8, 713719

N95-215 TITLE: Optimization of Casualty Handling

OBJECTIVE: Determine the applicability of modeling and simulation to the representation of the logistics of medical emergencies.

DESCRIPTION: Emergency medical treatment of mass casualties is a classic example of a system stressed by surge inputs with the need to optimize resources. A mass casualty situation at sea is further compounded by an operating environment that is severe and demanding, including loss of the medical treatment facility and the possible injury or death of medical providers due combat damage or loss of a vessel. Regardless of operating environment, the medical requirement in a mass casualty situation is to move patients through a triage system to appropriate care providers and echelons of medical care. Modeling and simulation tools can be used to investigate and assess medical system options and their efficacy in treatment of surge casualty situations. Current object oriented and intelligent agent programming paradigms can be used to develop computer simulations that would support dual use military and civil applications. Such a simulation would be useful in the assessment and enhancement of current care systems, in the design of new systems, and for training of care providers in a synthetic environment setting.

PHASE I: Develop a preliminary PCbased simulation to assess medical operations in a naval environment. The simulation system must at a minimum incorporate models of the medical care system, enemy threat, shipboard damage and casualty production.

PHASE II: Deploy at least two of prototype system that are Distributed Interactive Simulation (DIS) compliant for field testing.

PHASE III: Conduct field testing and evaluate prototype system.

COMMERCIAL POTENTIAL: This prototype, which incorporates mass casualty models and simulations, has the potential for application as a training and as a planning system for disaster relief as well as city emergency services personnel.

REFERENCES:

1. Alluisi, E.A. "The development of technology for collective training: SIMNET, a case history," Human Factors, vol. 33, no. 3, 1991, pp. 343362.

NAVAL SUPPLY SYSTEMS COMMAND

N95-216 TITLE: Articulated Instrumented Manikin

OBJECTIVE: To develop a durable, fire retardant, variable speed, articulated, anthropometrically correct, instrumented manikin.

DESCRIPTION: There exists a need for a durable, fire retardant variable speed, articulated, anthropometrically correct, instrumented manikin to simulate a six foot tall, size 40 Regular, muscular well conditioned adult male. The manikin will be used to measure the burn injury potential of fire retardant clothing worn by a person escaping a shipboard fire. The manikin shall possess the capability of obtaining measurements with up to 110 total heat flux transducers or skin simulants, with access points for repairs at the center back, upper arm, forearm, thigh, and calf. The internal wires from the sensors will exit the manikin through a molded aluminum pipe located in the head of the manikin. The hands and feet of the manikin will be solid, and not possess any sensors. The sensors shall be mounted as flush as possible with the fiberglass exterior of the manikin. The distribution of the sensors shall be approximately one per unit surface area. The system shall have the flexibility to disconnect any sensors not necessary for any one particular test run. The manikin will be suspended from a variable speed traversing system. The manikin will be fire resistant and durable to withstand multiple large scale fuel fire envelopment at exposure levels of 2.0 to 5.0 gram calories per square centimeter. The manikin system will be exposed to these heat levels for short periods of time, typically five seconds or less. The manikin shall be articulated in such a way that while passing through the fuel fire via a variable speed traversing system, the manikin will simulate a walking to running motion of the arms, legs, and torso.

PHASE I: Research means to develop the system and test the components to see if they meet the requirements.

PHASE II: Develop prototypes for testing and approval.

PHASE III: Successful testing of the operation of the system will be conducted prior to final approval by the Navy.

COMMERCIAL POTENTIAL: Both state and local governments and private sector would receive major payoff from new specifications and products (such as clothing, etc.) derived from the knowledge gained from enhanced thermal simulations.

REFERENCES:

1. Dale, J.D., E.M. Crown, M.Y. Ackerman, E. Leung, and K.B. Rigakis (1992) "Instrumented mannequin evaluation of thermal protective clothing". In J.P. McBriarty and N.W. Henry (Eds.), Performance of Protective Clothing, Fourth Volume, ASTM STP 1133, Philadelphia: American Society for Testing and Materials.
2. Crown, E.M., Dale, J.D. "Built For The Hot Seat" Canadian Textile Journal, March 1993.
Brown, W., ASTM Subcommittee F08.53.02, "Athletic Equipment that Helps Prevent Cervical Spine Injuries Via Hybrid III Anthropomorphic Test Devices (ATD)" ASTM, Philadelphia (215/2995499). ASTM Standardization News, April 1994.

N95-217 TITLE:Active Thermal Absorbing/Insulative Materials

OBJECTIVE: To reduce the heat transfer rate through fire fighter's clothing to allow longer exposure time for fighting the fire without increasing weight or decreasing the functionality and durability of the overall garment system.

DESCRIPTION: Tolerance time of the firefighter is currently limited by the rapid rate of heat transfer through the fire fighter's clothing which leads to discomfort, heat stress and potential burn injury.

PHASE I: The contractor shall develop a minimum of three specific durable liner materials which exceed the thermal performance characteristics of the current battings, by specifically reducing the heat transfer rate and also meeting or exceeding all other physical characteristics applicable to liner materials. The contractor shall also provide supporting data to prove efficacy of those materials for use in fire fighting clothing, conforming to National Fire Protection Association Standard (NFPA) 1971 for thermal barrier material. Deliver one square yard of each of the prototype materials practical for use in garments and of a width required to perform tests specified in NFPA 1971.

PHASE II: The contractor shall optimize prototype materials identified in Phase I for human factor acceptance. Produce ten fire fighter's garment liners from each of the two best candidate materials developed in Phase I. Government accepted garment patterns and construction techniques shall be used. Provide data pertaining to thermal protection results, cost effectiveness and manufacturing viability for the intended application.

PHASE III: The contractor shall finalize manufacturing methods and cost effectively deliver 100 fire fighter's garment liners fabricated from the selected material.

COMMERCIAL POTENTIAL: Tremendous potential exists to transition this technology to all military services and the private sector fire fighting community and to any application requiring enhanced thermal protection.

REFERENCES:
1. NFPA 1971/1976

N95-218 TITLE:Application of Neural Networks for Pattern Recognition in Logistics Data

OBJECTIVE: Develop techniques for the application of Neural Network technology against large transaction history data bases to identify complex patterns not currently considered in logistics math models. The development process will include specific application to Navy Logistics history records and inventory records with the intent of establishing improved criteria for the management of spare parts and repairables based on currently unseen patterns in past transactions. Development will necessarily include procedures for development of the initial pattern recognition neural network, "training" the network with data base records, and operational procedures for the system in a LAN environment. It is intended that this technology will be combined with the use of PC/LAN/multi-processor technology to process large data bases and computation intensive tasks on a client-server basis; and with standard object oriented application development tools (such as visual basic and visual C) providing a standard use software.

DESCRIPTION: Neural network technology has been used successfully for complex pattern recognition applications. Standard forecasting techniques involve the processing of large amounts of data base information and complex mathematical functions, but cannot take into account the more complex patterns caused by changes in maintenance plans, fleet operations, tempo of operations, mission assignments, operating hours, etc. While these may be adjusted for and managed well by the human involvement in Supply Management, the experience and capability to plan is lost, or at least diminished, when the person changes. The development of Neural Network technology to recognize these complex patterns and relationships can provide improved planning tools and forecasting capabilities. As the capability to efficiently handle large data bases has improved and as processing power increases, the use of such complex tools becomes possible and effective.

PHASE I: Conduct a six month study of UICP, DLA, and CNO data base records and current processing capabilities. Review computing requirements for utilization of Neural Network technology. Develop a plan for establishment of a suitable pattern recognition Neural Network and for the further training of that network with the data base records that are available. The plan should include details for maximizing the use of current LAN processing capabilities, and a theoretical proof of the technology's capability to improve on current forecasting.

PHASE II: Develop and refine the system to provide improved forecasting accuracy, timeliness of procurement, and location of assets. Deliver and train a Neural Network based on the plan developed in Phase I. Conduct a comparative study of the technology against current forecasting techniques.

PHASE III: The processes and programs will be fully documented and transitioned into full use. Procedures for development of other applications will be provided for Navy use. Key Navy personnel will be thoroughly indoctrinated into the application techniques used.

COMMERCIAL POTENTIAL: The technology has significant commercial possibilities for the recognition of complex patterns within business and economic systems; and specifically in inventory management.

NAVAL SURFACE WARFARE CENTER/SSPO

N95-219 TITLE: Thermal Management for Strategic System Nosetips and Leading Edges

OBJECTIVE: Develop ablation-resistant nosetip and leading edge materials/systems for use in high-heating-rate environments.

DESCRIPTION: Current strategic system reentry bodies (both Navy and Air Force) utilize ablative materials for the nosetips. Advanced materials and/or thermal management systems are believed to be needed to provide ablation-resistant response and, thus, to provide future system accuracy and performance needs. A possible solution approach is the combination of an ultra-high-conductivity material (such as diamond) with a thermal management system (such as a heat pipe). It is emphasized that high reliability is required, which suggests solution approaches which are passive, simple, self-contained, and possess long shelf-lives.

PHASE I: Identify one or more ablation-resistant nosetip/leading edge concepts. For the materials selected, chemical stability shall be shown for all materials and material interfaces (internal and external) through the range of temperatures to be experienced.

PHASE II: Technology areas critical to the prediction of acceptable performance and to the construction and demonstration of a ground-test article are to be completed. Given suitable flight trajectory parameters, design calculations are to be performed to identify the final design of the demonstration article to be fabricated in Phase III.

PHASE III: Fabricate and conduct arc-heather (and other, as necessary) ground testing of the nosetip/leading edge design produced in Phase II.

COMMERCIAL POTENTIAL: Applications which require management of high heat fluxes would benefit from the materials or systems developed. For example, thrusters on satellites or their launch vehicles or on the leading surfaces of future hypersonic air vehicles. Also, these may provide a thermal management system for advanced, high temperature gas turbine or internal combustion engines.

REFERENCES:

1. Kardell, M.P., et al., "Arc-Heater Ground Testing of Oxidation-Resistant Carbon-Carbon Materials," NSWC TR 87-32 (Feb 1987). (Avail DTIC).
2. Baskin, Y., et al., "Failure Mechanisms of Solid Propellant Rocket Nozzles", Ceramic Bulletin, vol. 39, no. 1, (1960), pp. 14-17.
3. Campbell, J.G., "Refractory Chamber Materials for N2O4/Amine Propellants", AFRPL-TR-73-1 (May 1973). (DTIC AD-762531)

N95-220 TITLE: High Definition Spatial Light Modulators for Displays Methods

OBJECTIVE: The development of a high definition, high speed spatial light modulator and its demonstration in a two-dimensional display.

DESCRIPTION: Improved spatial light modulators that convert electrically stored information into parallel coherent images are critical in the development of a high definition, high speed, two dimensional display and image correlation. Unfortunately, current technology based on liquid crystals provides inadequate performance. New optical materials, such as inorganic Electron Trapping Crystals, combined with new device structures or operating principles are needed. Design goals include a resolution of 1024 x 1024 pixels with 256 gray levels, a contrast ratio greater than 10,000 to 1, a frame rate of at least 100 kilohertz and the capability to operate between 450 and 1350 nanometers.

PHASE I: Identify optical materials and predict performance in a spatial light modulator. Design a high definition, high speed modulator for use in a display and in image correlation.

PHASE II: Optimize modulator design for a Navy display application. Construct prototype and provide laboratory demonstration of performance.

PHASE III: Transition to an Advanced Development Program which includes improved displays and/or correlators.

COMMERCIAL POTENTIAL: Advanced displays needed in medical image analysis, security surveillance, machine vision systems and high definition projection systems. Spatial light modulators used in optical data processing, optical pattern recognition and fiber optics.

N95-221 TITLE: Software Automation for Distributed System Development

OBJECTIVE: Develop an automated software system to aid in the development and use of distributed systems and their components.

DESCRIPTION: A unified process is needed for re-thinking conventional processes in the design and building of software. The process should consider the use of some of the many computer Aided Software Engineering (CASE) tools currently available in developing a high level approach to both the design of new systems and dealing with the similarity between the definition of the software problem and its solution. Integrity and independence of components should allow the isolation of errors and the easy extension to new applications. These attributes should be combined with an appropriate human interface to provide guidance to both system developers and problem solvers.

Techniques which claim to address some aspects of above attributes include object-orientation, knowledge-based systems, concurrent engineering, rapid prototyping, executable specification, and system modeling.

PHASE I: Demonstrate the feasibility of an approach for the extended automation of software development (initial construction and subsequent evolution.)

PHASE II: Develop a prototype software automation system and assess its utility.

PHASE III: Apply to Navy applications such as fire control systems.

COMMERCIAL POTENTIAL: Commercial computer systems using client server technology

REFERENCES:

1. Case Trends, Vol 5, #3, April 1993.
2. Jim Stikeleather, "Why Distributed Object Computing is Inevitable", Object Magazine dated March/April, 1994

BUREAU OF NAVY PERSONNEL

N95-222 TITLE: Command-Level Drug Testing Strategy

OBJECTIVE: To design and develop a system for analyzing the impact of alternative command-level personnel drug testing strategies.

DESCRIPTION: Any drug use compromises force readiness and introduces additional costs to both the service member and the Navy. The Navy's zero tolerance drug policy includes a random urinalysis testing policy for all military personnel. The effectiveness of such testing would increase if commands used a selection strategy which maximizes deterrence and minimizes the time until detection.

PHASE I: Develop a methodology for determining the probability of detecting drug users under a comprehensive collection of alternative scenarios of drug use, crew composition, and testing strategies (selection of days and monthly testing rates). Develop all design specifications for incorporating this methodology into a command-level system.

PHASE II: Develop a methodology for selecting individuals in accordance with the methodologies developed in Phase I for use at the command-level. Develop all design specifications for incorporating this methodology into a command-level system.

PHASE III: Produce a marketable system for analyzing alternative drug testing policies and selecting individuals for testing at the command level.

COMMERCIAL POTENTIAL: Drug testing is gaining acceptance as a means for deterring drug abuse in the workplace. A system for analyzing the effectiveness of alternative drug testing strategies and selecting individuals based upon such analyses would be of great benefit to all commercial enterprises with random drug testing programs.

N95-223 TITLE: Adaptive Tutor for Conceptual Knowledge

OBJECTIVE: Design and develop prototype tutoring system which addresses learning, retention, and application of conceptual knowledge.

DESCRIPTION: Although the last two decades have seen increases in the sensitivity, reliability and efficiency of sensors available to Navy operators and tacticians, there has been no demonstrated improvement in the conceptual understanding of the crew who employ them. The status quo remains, e.g., tendencies to form and disseminate misconceptions, inability to explain or predict sensor performance in unique and previously unencountered situations. There is a need for better ways to train and assess conceptual knowledge to ensure effective learning, retention, and application.

PHASE I: Design and develop a prototype tutoring system in a domain heavily comprised of conceptual knowledge (e.g. acoustical oceanography). The description of the instructional strategy is to include, but not be limited to, diagnostic learner assessment, presentation, practice, and feedback strategies and issues.

PHASE II: Continue development of the adaptive tutoring system. Use results of initial trials to modify the instructional strategies employed in the prototype tutor. Expand prototype to include additional lessons in related topic areas (e.g. atmospheric effects on RF emissions). Identify potential/target education and industry users. Develop a marketing plan.

PHASE III: Expand the tutor, using the design employed in Phase II, to address conceptual knowledge in other educational or industrial domain(s). Implement the tutor for target users.

COMMERCIAL POTENTIAL: The commercial potential for the product, if applied to the acoustical oceanography domain, is in the areas of oceanography, underwater survey and salvage and geology. General application may also be made to educational and industrial training programs.

N95-224 TITLE: A Tool for Modeling Distributed Decision Making in Complex Environments

OBJECTIVE: To develop an assessment tool to aid in the design of distributed decision making systems as well as help in determining the training requirements of such systems.

DESCRIPTION: The use of distributed decision making and various decision architectures has been documented in complex integrated work environments. Complex environments require decision support networks, centralization of data bases, and advanced communication channels. Effective systems can be designed from reliable models of the organization, environment, and distributed decision making tasks. Automation of these models is vital for analyzing advanced system needs. Automated methods are being sought that:

- Diagnose the information processing and decision making needs of a complex organizational environment.
- Identify decision architectures and communication networks that meet the decision requirements of an advanced organization.
- Prescribe and integrate strategies for effective distributed decision making in complex environments in an automated format.

The resulting automatic assessment tool will be useful in helping an organization to determine the nature and architecture of decision making systems (with emphasis on distributed system) required to optimize its effectiveness.

PHASE I: Develop and validate a model of distributed decision making that incorporates organizational, environmental, information, and communication constraints. Synthesize pertinent literature, as necessary.

PHASE II: Design and prototype an assessment tool that can aid organizations in determining the appropriate decision systems to accomplish their goals.

PHASE III: Apply the tool using military and private organizations.

COMMERCIAL POTENTIAL: This technology for distributed decision making systems can be developed to assist organizations in becoming more productive and effective.

REFERENCES:
1. RASMUSSEN, J., et al., (Eds.), 1991, Distributed Decision Making: Cognitive Models for Cooperative Work. New York; John Wiley & Sons.

NAVAL FACILITIES COMMAND

N95-225 TITLE: Eliminating Fatigue Failures in the Navy Infrastructure

OBJECTIVE: Develop nondestructive methods to quantitatively locate and size structural flaws in metals which propagate into fatigue cracks. Develop a procedure to determine the material toughness (the material's resistance to fracture) in a nondestructive manner.

DESCRIPTION: Fatigue failures in the Navy cranes pose a significant threat, especially for 1940 vintage cranes handling nuclear material during shipyard operations. The Navy has already experienced many fatigue failures in critical crane components resulting the uncontrollable dropping of the load. Current NDT fatigue crack location techniques are not suited for the inspection of many critical cranes components. Methods today are very time consuming, inaccurate and difficult to use. Many techniques utilizing emerging technology require extensive surface preparation and internal flaw detection and can only be accomplished by a scientist with years of experience and the capability to decipher the data. A nondestructive method for determining the material toughness also needs to be developed. Current techniques require large specimens to be cut out of the existing component leaving the component unable to sustain service loadings. A prospective method should be simple to operate and not require exhaustive sampling.

PHASE I: Evaluate techniques applicable to locating fatigue cracks and determining the material toughness in structural metals. Specifically address nondestructive techniques for determining the crack size, orientation and material toughness. Develop and construct prototype tools capable of quickly and accurately determining the required fatigue properties.

PHASE II: Test prototype nondestructive inspection and material toughness tools in field-like applications for their accuracy, precision, accessibility and ease of operation. Prepare a report of the findings and make recommendations for preparing the tools for field use. Complete a failure mode and effects analysis of the design, manufacturing and operational process associated with each inspection tool.

PHASE III: Construct an actual inspection tool for commercial use. Developed tool will transition to the advanced development within the Navy's Advanced Diagnostic, Structural Repair and Upgrade Program. The Navy is interested in utilizing the developed technology on its own large cranes and enter into marketing efforts with crane operations at major private shipyards.

COMMERCIAL POTENTIAL: The results of this development will provide the commercial sector with a method for an easy, cost effective procedure to locate fatigue cracks and give the engineer the material properties required to make accurate residual life predictions. No method exists today that can nondestructively obtain necessary fatigue properties.

N95-226 TITLE: Rapid Pipe Pile Cutoff Technology in Support of Amphibious Logistics Operations

OBJECTIVE: Develop the technology that can be used to cutoff steel pipe pile with a maximum diameter 30 inches within minutes. The cutoff operation will be performed on dry surface of an elevated causeway using only one unskilled laborer assisted by a crane.

DESCRIPTION: Amphibious Operations make use of the Modular Elevated Causeway Systems, ELCAS(M) to transfer containerized cargo, vehicles and materials from ships moored offshore to an unimproved beach staging area. Elevated causeways are supported by piles driven into sea floor sediments. After pile foundations are installed, top-mounted pulleys lift the causeways above the water surface. The construction of the ELCAS(M) starts from beach and extends to offshore. After a causeway is elevated, piles jutting above the elevated causeway must be cutoff to allow forklifts to transport a causeway section to the next erection. The current practice of using a welder torch to cutoff a steel pipe pile of 24-in diameter requires about 15-20 minutes. During cutting, a crane must hold the pile upright. For a 3000-feet causeway, more than 160 piles must be cutoff, meaning that the crane will be tied up for 60 hours. While the Navy has not ruled out the concept of using explosive/ shaped charges if a safety measure is developed, it would be preferable to develop a concept that would be useable in a highly congested work area.

PHASE I: Evaluate new technologies for pile cutoff. Perform engineering assessment and trade-off studies to determine the feasibility of these technologies, and recommend an optimum concept. Document the results of the engineering assessment and the trade-off study. Design, develop and construct a prototype pipe pile cutting system. Safety considerations need to be addressed in tandem with the technology development.

PHASE II: Perform prototype tests in the laboratory. Perform modifications to correct technical deficiencies encountered during the tests. Demonstrate the prototype in field tests and deliver a enhanced cutting system.

PHASE III: Develop technology transfer mechanisms such as informal seminars and presentations at trade shows. Commercial development assistance will be provided by the NAVFAC project on JLOTS Improvements.

COMMERCIAL POTENTIAL: The results of this study can be readily applied to both the onshore and offshore projects such as the construction of bridges, plants, buildings constructed on pile foundations and for various pipeline industries. The Navy is interested in applying the developed technology over a broad industrial base.

N95-227 TITLE: Portable and Light Surface Mapping/Volume Measurement Tool

OBJECTIVE: Develop an inexpensive, portable and light tool that will accurately map the surface and/or compute the volume of small depressions on the surface of cylindrical cables. The depressions would measure no larger than 20 mm by 20 mm square and 10 mm deep, and could be significantly smaller.

DESCRIPTION: In the study of undersea cable abrasion, it is necessary to measure the amount of the cable material that has been removed by a particular abrasive after a known period of time. The shape and roughness of the wear zone is dependent on a number of factors including the cable tension, the degree to which the cable is embedded in or wrapped around the abrasive, the distance the cable travels on each abrasive stroke, and the shape and hardness of the abrasive. This combination of factors makes each wear zone different. Simply measuring the change in diameter is not adequate; a tool that maps the surface of the wear zone, or at least measures the volume of material worn away, is needed. The proposed system would preferably provide readings in real time.

PHASE I: Provide a concept and investigate the feasibility of a portable and light surface mapping/volume measurement tool. Report on the technology selected and its anticipated effectiveness as part of the surface mapping/volume measurement tool.

PHASE II: Manufacture a working prototype of the tool. Thoroughly test the device in order to verify its accuracy, precision, range, and susceptibility to environmental conditions.

PHASE III: Transition the tool to SPAWARS Cable Survivability Program.

COMMERCIAL POTENTIAL: An inexpensive, portable and light, field ready surface mapping/volume measurement tool would be of use to such diverse fields as criminal forensics (studying exact shape/volumes of indentations from impacts), geology (looking at the shape/volume of samples while in the field), and the manufacturing industry (monitoring parts on the production line).